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ABSTRACT

The effect of adjunct aids on comprehension of expository text by seventh grade poor readers was investigated. The adjunct aids were activities designed to invite readers to make inferences required in order to understand the text, a 1,300-word passage on the Kalahari Desert. Two treatment groups received activities with graphic locational aids, one simultaneously with the reading and one after an initial reading of text. Two treatment groups received the same activities without graphic aids, one simultaneously with the reading and one after an initial reading of text. Results of comprehension tests indicated that the inference making activities were effective at increasing the subjects' comprehension. Groups who read the activities after reading the text outperformed the groups who received activities and text simultaneously. Groups who received graphic locational aids did not outperform the other treatment groups. (Author/MKM)

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Technical Report No. 555

EFFECT OF INFERENCE-MAKING AIDS ON POOR READERS' COMPREHENSION

by
Petey Young

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Report from the Project on
Studies in Language: Reading and Communication

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Petey

Beijing
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EFFECT OF INFERENCE-MAKING AIDS ON
POOR READERS' COMPREHENSION

Petey Young

Under the supervision of Professor Wayne Otto

Abstract

The effect of adjunct aids on comprehension of expository text by seventh-grade poor readers was investigated. The adjunct aids were activities designed to invite readers to make inferences required in order to understand the text, a 1300-word passage on the Kalahari Desert. Kintsch's (1974) system of discourse analysis was used to analyze the text in order to (1) identify where to aim activities, and (2) write test items designed to assess comprehension of the passage. A multiple-choice test and a recognition test were written on the passage and validated prior to the main data collection. These were administered (1) immediately after treatment or control procedures, and (2) again two weeks later. Scores from these four tests were used to assess the comprehension of four treatment and two control groups, each containing 22 subjects.

Two treatment groups received activities with graphic locational aids, one simultaneously with the reading and one after an initial reading of text. Two treatment groups received the same activities

without graphic aids, one simultaneously with and one after reading. The two control groups did not receive activities. One control group read the text for as long as the subjects wished. The other read for approximately as long as the average time the treatment groups spent reading and doing activities.

When the combined performances of the four treatment groups were contrasted with the combined performances of the two control groups (Hypothesis 1), one-way analyses of variance showed that the treatment groups outperformed the control groups at a $p < .001$ level of significance. The inference-making activities were concluded to be effective at increasing comprehension with these subjects and materials. When the combined performances of the groups who received activities after reading the text were contrasted with the combined performances of the groups who received activities and text simultaneously (Hypothesis 2), one-way analyses of variance showed that the former outperformed the latter at a $p < .001$ level of significance. The presentation of activities after text was read was concluded to be a critical factor in enhancing comprehension by means of inference-making activities. When the combined performances of the groups who did not receive graphic locational aids were contrasted with the combined performances of the groups who did (Hypotheses 3), significant differences were generally not found. Embellishing the activities with graphic locational aids was concluded to be unimportant in facilitating comprehension by means of inference-making activities.

Scheffé procedures, in which pairs of treatment groups were contrasted with individual control groups, and one-way analyses of variance of scores from the activity-specific and activity-irrelevant items in the multiple-choice test confirmed the findings from the testing of the three hypotheses.

APPROVED: Wayne Otto
Wayne Otto

DATE: 11 July 1980

CHAPTER I

PURPOSE, RATIONALE AND HYPOTHESES

Results of numerous studies have shown that adjunct aids in the form of written activities to be completed by readers before, during, or after reading can increase comprehension of what is read. However, why and when comprehension increases has not been determined. Perhaps this is because within the vast amount of research on adjunct aids little consideration has been given to where in the semantic structure of text adjunct aids have been focused or to the kind of comprehension problems that adjunct aids address. In order to understand why written activities accompanying text can facilitate comprehension, it seems essential to know what in the text is being brought to the readers' attention and how the readers are being asked to deal with it. This information is needed before the possible roles that adjunct aids might play can be determined or even systematically studied.

Researchers who would determine if and how adjunct aids facilitate comprehension must first decide: (1) where in the text to direct the readers' attention; (2) when and how to ask readers to deal with the textual information focused upon; (3) how to ascertain whether or not readers have gained in comprehension afterwards; and (4) how to give consideration to the generalizability of effects among students of varying abilities and backgrounds. Unfortunately, research findings give insufficient prescription for making these decisions.

The reason for the lack of prescriptive findings may be that an understanding of the semantic structures of the texts upon which adjunct aids focus is crucial to solving the problem of when and why comprehension increases following their administration. If so, the problem at hand is to elucidate the relationships between the semantic structures of texts and adjunct aids. These relationships need to be understood so that the decisions about how and when to accompany text with written activities can be made less fortuitously than they have been up to now.

Purpose

The purpose of this study was to address the question of whether or not doing written activities involving text-based inferences improves poor readers' comprehension of expository text. Two related questions were addressed. First, is poor readers' comprehension of expository text affected by presenting inference-making activities simultaneously with text or after an initial reading of text? Second, is the comprehension of text affected by presenting the activities along with graphic aid designed to help students locate answers?

Rationale

The rationale for this study is drawn from three lines of research. First, results of research in discourse analysis are examined in order to explain the use that was made of an analysis of text. Second, research on inferencing is shown to offer some support for the decision in the study to focus activities on places in text where readers are required to make inferences. Finally, the line of research which has dealt directly with how to facilitate comprehension of text through the use of written adjunct aids is reviewed.

Research on Discourse Analysis

Until recently the semantic structure of text could be analyzed only subjectively by applying common sense. Hence, the relationship between adjunct aids and the meaning of prose could not be systematically determined. If, as seems probable, comprehension is facilitated when adjunct aids invite the reader to focus on those sections of text which are essential to comprehension of the textual message, then systems of discourse analysis may offer new approaches to increasing the effectiveness of such aids.

Since 1972, a number of systems for analyzing the semantic structure of text have been developed by researchers concerned with prose comprehension and memory. These discourse-analysis systems, all of which use formats based on the concept of case grammar (Fillmore, 1968), differ in complexity and in the types of information they represent. Labels vary among the systems but all share the common purpose of identifying the function of information in prose. All are designed to identify those characteristics of text which could influence the way the text is processed by a reader.

A system of discourse analysis for analyzing expository prose was used in the present study to identify places in text where readers are required by the text to make inferences. The systems developed by Kintsch (1974), Meyer (1975), and Frederiksen (1975) have been used to analyze expository, as well as narrative, prose. Of these three systems, the network system developed by Frederiksen is the most time-consuming and complex. Although the system can be used to identify where inference-making is required, the resulting analysis extends to such consideration of detail that some method for collapsing across categories is needed in order to identify inferences necessary for overall comprehension of the text. Methods for doing this, or for otherwise simplifying Frederiksen's system, have not been published. In contrast to Frederiksen's system, the network system used by Meyer is relatively parsimonious, and she claims to be able to train people to use it for research purposes within a short time. However, Meyer's system represents only those ideas which are directly expressed in the text. Since her analysis does not include a way to represent inferences, the system is not appropriate for use in this study. On the other hand, the system developed by Kintsch, and further clarified by Turner and Greene (1977), is considered to suit the purpose of this study.

Kintsch's System

Kintsch's (1974) system is part of a model of semantic memory and can be used to represent the meaning of text both as it is written by an author and as it is organized in memory. In contrast to Meyer (1975), Kintsch's primary concern is with how written information is perceived by the reader rather than with how the organization of prose is presented by an author. He rejects networks as ungainly and uses a hierarchical list of propositions (ideas) from which recall can be predicted. The list-like structure is a major simplification compared to network systems such as Frederiksen's (1975). Kintsch uses a linear cohesion whereby propositions are connected by a repetition rule and superordinate propositions have subordinate propositions as arguments.

Although Kintsch's system, like Grimes' (1975; Meyer, 1975), is based on case grammar (Fillmore, 1968), unlike Grimes' it does not specify the higher organizational schema of a text. Kintsch's system, as further described by Turner and Greene (1977), represents the overall organization of a text by using various classes of micro-propositions. Kintsch (1974; Turner & Greene, 1977) distinguishes among classes of propositions according to three classes of relations: predication, modification, and connection. The predication class of propositions consists of ideas of action or being, and the relations in predication propositions are usually verbs. Two types of predication propositions are identified, nominal and referential. The modification class consists of propositions which change a concept by modifying it in a restrictive fashion by means of another concept. The four types of modification propositions are: qualifiers, quantifiers, partitives, and negations. The connection class consists of propositions which relate propositions to each other. These propositions are important for cohesion and may need to be inferred because they are unexpressed in the text. The arguments of these propositions tend to be other explicit or implicit propositions. The eight types of connection propositions are: conjunction, disjunction, causality, purpose, concession, contrast, conditions, and circumstance. Circumstance propositions involve time, location, or mode of action. Turner and Greene's (1977) manual for using Kintsch's system extends the use of the system from analysis of sentences to analysis of text and provides a step-by-step procedure for analyzing extended passages.

Although Kintsch and van Dijk's (1978) model lacks a theory of inference, it is being developed to account for inferences. At present, Kintsch's system allows the identification of places in the text where readers must make inferences or must remember previously stated concepts no longer predicted by the model to be in working memory. Potential inferences are identified through a coherence rule whereby connections are formed whenever two propositions share an argument. These connections may be explicit or implicit in the text. Implicit connections (inferences) are denoted in Kintsch's system by a > placed in front of the proposition. Although Kintsch's system has not yet focused on the inference mechanisms beyond denoting the occurrence of inferences, Kintsch (1979) stated that "clearly they (inference mechanisms) will be a very important part of a complete comprehension model" (p. 12).

The use of Discourse Analysis in the Study

The passage which was read by the subjects in this study was analyzed by means of Kintsch's (1974) system of discourse analysis. The analysis (Appendix B) was used for two basic purposes. First, the analysis permitted the investigator to make a relatively objective choice of where in the passage to direct the accompanying activities in order to help a reader make the inferences necessary for comprehension. To make this choice, all referential and inferred propositions were examined in terms of the explicitness and proximity of the information referred to. Then the importance of referential and inferred propositions to the textual message was determined from a coherence graph of the passage (Appendix C). A selection of propositions important to comprehension of text was made from propositions which: (1) lack explicitness; (2) are insufficiently linked to other propositions; and (3) refer to previous information possibly no longer in the reader's working memory. The activities accompanying the text were directed at the places in the text where such propositions occur.

Second, the analysis of the passage was used to guide the writings of the immediate and delayed tests of comprehension. Kintsch's system yields three or more levels of textual information even without confirmation from readers' protocols. The finer-detail levels were collapsed to the third level of text information when the analysis yielded more than three levels, and an equal number of test items was directed at each level. The analysis of the passage was used to determine (1) whether or not more than one test item taps identical information, and (2) the extent to which test-item information was provided in the activities.

Research on Inference-making

Although the relationship between ability to make inferences and reading ability has been little explored, common sense would suggest that inference-making is an integral part of comprehension. However, when inferences are made during comprehension, what the inference processes are, and how they operate has not been established. Furthermore, since most of the information about inferencing during reading has come from studies involving narrative prose, the applicability of the information on inferencing to expository prose is unknown.

The Relationship Between Inference-making and Comprehension

Comprehension of language consists basically of semantic, not syntactic, understanding (Fillmore, 1968; Frederiksen, 1975a; Grimes, 1975). In turn, semantic understanding consists of the application of knowledge and the making of inferences (Kintsch, 1974; Schank, 1975ab). In mental processing these two basic components of comprehension are combined in order to organize incoming textual information. Inference-making plays its role in structuring the incoming information by filling in information missing in the text and by connecting events in the structure with other events (Schank, 1975ab).

Although inference-making is as yet loosely defined and relatively unexplored in reading research, researchers have suggested not only that inferencing is predictive of comprehension (Paris & Upton, 1976) but also that inferencing is the most critical component of comprehension (Kintsch, 1979).

If, as has been assumed, inference-making takes extra processing time (Haviland & Clark, 1974), then perhaps successful readers must learn to take time to process information whenever an inference must be made. One way to invite readers to develop strategies for taking extra processing time may be by aiming activities which accompany text at places in the text where the need for readers to make inferences can be predicted.

Inferencing at Encoding or at Retrieval?

The question of whether a reader normally makes inferences at encoding (during input) or at retrieval (during output) is basic to an understanding of the role of inferencing in comprehension. However, the question is unanswered. Results of studies by Kintsch and Keenan (1973) and McKoon (1977) can be interpreted as consistent with a hypothesis that inferencing occurs at encoding. On the other hand, Frederiksen (1975bc), reporting on the increase of frequency of inferences upon repeated readings of the original text, interpreted his results as supportive of the hypothesis that inferences are made at the time of comprehension and are not elaborations made later to fill in gaps.

Spiro (1975) reported two studies supporting his SPPI (superficial processing of presented inferences) hypothesis by which all predictable information (inferences) is processed only superficially and at encoding receives very little or no cognitive representation from the reader. Spiro suggests that much of what is read is predictable and hence taken for granted by the reader and passed over. In this process when information retrieved at recall is insufficient to produce coherency, the reader takes care of the deficiency by generating inferences either from the fast-fading predictable information or from some other source.

Since the controversy over whether, or to what extent, normal inferencing occurs at encoding or at retrieval has not been settled, the position taken in the present study is that inferencing may occur either at input or at output. Hence the activities which accompany the text are designed to accommodate either process. The activities require students to check out inferences necessary to the text message that may have been made at encoding, to make the inferences then if they have not already done so, and to correct any previously made, inappropriate inferences.

Inferencing Processes

Inferences are "the procedures which enable us to take what is explicit in the text, apply our world knowledge of it, and come up with its meaning" (Warren, Nickolas & Trabasso, 1979, p. 23). Little is yet known about what these procedures are and how they operate; furthermore no adequate methods exist for assessing what inferences are made during reading (Warren, Nickolas & Trabasso, 1979). Among the inferencing processes discussed in the literature, two intermeshing processes are consistent with Kintsch's (1974) model of comprehension: the process of forming Given-New contracts and the process of making bridging inferences.

Given-New contracts. The concept of the Given-New contract comes from Clark's (Haviland & Clark, 1974; Clark, 1975; Clark & Haviland, 1977) model of conversational comprehension. The way Clark's Given-New contract deals with inference in comprehension is consistent with the way Kintsch and van Dijk's (1978) processing model deals with coherence. However, although referential coherence has an important function in Clark's system, his ideas about the inferencing process are not limited to it, and Kintsch and van Dijk (1978) stated that Clark's notions may indicate possible extensions of the way their model handles inference.

In Clark's model, comprehension is presented as a process of adding new information to information that is already known. Material that should already be known is called Given information and material that has not been known is called New information. Although Clark's model is designed to explain conversational comprehension, by changing "hearer" to "reader" and "speaker" to "text" his model may offer insights into reading comprehension. According to Clark, in order for comprehension to occur in the hearer, the relationship between Given and New information must be established either by using the syntactic constructions in the speaker's sentences to locate the necessary Given information in memory and relate it to New information, or, when the necessary memory does not exist, by constructing the relationship through an inference. Clark considers that a contract exists between the speaker and the hearer by which the speaker contracts to follow certain rules of conversation and the hearer contracts to use comprehension strategies that depend on the rules being followed.

For lack of another model, Clark's model of conversational comprehension, which is new and not well-tested, is considered in the present study to apply to expository prose. The activities accompanying the text in the proposed study are designed to aid the reader in fulfilling his part of the Given-New contract in two ways. The activities focus on places where (1) the text does not appear to have fulfilled its parts of the Given-New contract because an important textual message is ambiguous, and (2) readers may not be able to fulfill their part of the Given-New contract because important information necessary for comprehension is no longer predictably in working memory or is not predictably in the readers' world knowledge. In the first case, the activities are designed to lessen the ambiguity. In the second case, the activities direct the readers' attention to previous information or help convey the necessary world knowledge.

Bridging inferences. Bridging inferences, which have been studied by Clark and his colleagues (Haviland & Clark, 1974), are inferences that are necessary to interrelate propositions. These inferences involve reinstatement searches (searches in memory for links) that range from single connections such as pronoun references to complex connections between concepts which are not presented in close conjunction in the text. Making bridging inferences often involves erroneous conclusions based on incorrectly conducted reinstatement searches.

In order to make a correct bridging inference as he reads, the reader must conduct a mental reinstatement search whenever present input does not relate to propositions immediately available in his memory that can establish the coherence of the text. If, as Haviland and Clark (1974) claim, bridging inferences are made along the most readily available pathway, then the pathway may lead to world experience rather than previous information in the text. Hence the activities accompanying the passage in this study attempt to direct the readers' attention to previous text material whenever the readers appear required to make a bridge between important bits of information not presented in close conjunction in the text.

Inferences in Expository as Compared to Narrative Prose

Although this study involves expository prose, most of the research on making inferences has involved narrative prose. This was unfortunate for the purposes of the present study because extrapolating from results of studies involving narrative prose to those involving expository prose may be unwarranted. For example, Monaco and Harris' (1978) application to narrative prose of Meyer's (1975) system of discourse analysis, which was designed for use with expository prose, resulted in the only findings using the system which do not support Meyer's own findings. Meyer (1977) claimed that narratives are organized with predictable story-grammar structures while expository text takes other forms.

An inference taxonomy, developed to depict the event chain of a narrative (Omanson, Warren & Trabasso, 1979), has been used by Trabasso (in press) in combination with insights from a recent book on answering questions by Lehnert (1978), to categorize the types of questions which can be used to help find out if a reader has made certain inferences. However, these questions deal with material contained in simple story sequences, and the relevance of the types of questions to expository prose has been neither established nor suggested.

Summary of Research on Inference-making

Although inference-making appears to be an essential part of comprehension, the issues of when and how it occurs during mental processing are unresolved. Most of the research on inferencing has involved inferences made by young subjects from conversation or narrative text. Generalizing from results of studies involving narrative prose and conversation to expository prose may be hazardous. However, no results from studies on inferencing seem to contradict a hypothesis that comprehension might be facilitated by focusing a reader's attention on places where expository text requires the reader to make an inference.

Research on Adjunct Aids

A decade of research designed to turn the art of questioning into a science has not produced prescriptive findings. Consequently, practices which lead to predictable effects on comprehension of questioned or unquestioned information with any age or ability level has not been identified. However, during this time the pursuit of the effects on comprehension attributable to asking questions has involved the (1) placement of questions in text, (2) effects of questioning with different age and ability groups, (3) frequency of questions, and (4) type of questions. The following section explains the effect of findings from studies exploring these four variables on the design of this study.

Placement of Questions in Text

The problem which has been most frequently addressed in research on adjunct aids is whether prequestions (questions placed before text) or postquestions (questions placed after text) better facilitate comprehension of text. The optimal placement of questions in text is unclear, but the consensus of the literature on adjunct aids seems to be that postquestions and prequestions serve different purposes in comprehension (Anderson & Biddle, 1975; Faw & Waller, 1976; Hartley & Davies, 1976; Rickards & Denner, 1978).

Prequestions appear to set a purpose for reading, and studies by Peeck (1970), Frase (1970), Rothkopf (1972), and Frederiksen (1972) can be interpreted to show that, when students read text to answer a particular set of questions, they are less able to answer other questions that follow logically from the text. However a considerable number of studies support the notion that postquestions do help readers retain information not directly related to the questions (Rothkopf & Bisbicos, 1967; Frase, 1967, 1968; Rothkopf & Bloom, 1970; McGaw & Grotelueschen, 1972; Boyd, 1973; Boker, 1974; Swenson & Kulhavy, 1974).

The moratorium on research about the position of questions that Anderson and Biddle (1975) called for under the assumption that postquestions had been shown to be superior to prequestions was followed by Rickards' (1975) study indicating that conceptual prequestions, which require facts to be subsumed under given ideas, facilitate comprehension better than verbatim prequestions, which demand rote learning of ideas, and better than conceptual and verbatim postquestions. Rickards' findings are supported by research on advance organizers. Ausubel's (1960) concept of an advance organizer (a form of prequestioning) and results of studies using advance organizers (Ausubel & Fitzgerald, 1961, 1962; Ausubel & Youssef, 1963; Ausubel, 1978; Mayer, 1979) indicate that the guidelines for writing prequestions should not be the same as the guidelines for writing postquestions. Studies in which prequestions have appeared in the form of objectives (Duchastel & Brown, 1974; Kaplan, 1974) also indicate that the success of a prequestion is dependent on what the question asks. The conflicting results from studies comparing prequestions to postquestions may have resulted from attempts to control variables by using the same guidelines for writing the prequestions and the postquestions. A review of the literature on adjunct aids indicates that the effects of questions on comprehension cannot be compared solely on the basis of their position in the text.

Question placement in this study. Although the issue of what effect prequestions, as compared to postquestions, have is still unresolved, the question activities used in this study are placed after sections of text and therefore have the appearance of postquestions. However, the activities vary in format from the types of postquestions used in previous studies in two ways. Traditionally, postquestions refer only to the section of text immediately preceeding them, whereas the activities in this study sometimes refer to information in sections which have already been followed by activities. This occurs when the inference in the immediately preceeding section on which an activity is focusing requires memory of information in (an) earlier section(s). Secondly, postquestions do not traditionally focus on information which must be understood in order to comprehend information that is presented in the following section. The activities in this study sometimes focus on information necessary for comprehension of forthcoming text, and in this way the activities occasionally function as prequestions do.

Control of question placement in this study. Adjunct-aid researchers have taken careful measures to ensure that postquestions were read after the text was read. For example, (1) text and questions have been printed on slides and projected on screens (Rothkopf & Billington, 1974); (2) booklets have been prepared with text and questions on separate pages in the desired order and accompanied by instructions that students were not to turn back (Swenson & Kulhavy, 1974); (3) with large numbers of students, color-coding of booklet pages has been used to monitor whether or not students turn back (Anderson & Biddle, 1975); and (4) text and questions have been issued in separate envelopes with instructions to deal with the contents of one and replace it in its envelope before opening the next envelope (Rothkopf & Billington, 1975).

The use of procedures such as those listed above may make generalizing from results of research to application in the classroom risky for two reasons. First, information about the different purposes that prequestions and postquestions seem to serve may not be helpful in the classroom because students presented with postquestions accompanying text may create prequestions out of them by reading the questions first. In this study, an attempt was made to investigate whether or not requiring the students to read text first appears to be important. This was done by presenting some students with the text and activities simultaneously and presenting some students with activities after an initial reading of text.

Secondly, students in most of the studies investigating the value of postquestions have not been allowed to review the text. However, classroom practices involving textbook and workbook postquestions encourage students to review text while answering questions. Rickards and Denner (1978) urge that the possible discrepancy between research results and classroom results be dealt with by conducting studies in which students are allowed access to the previously read material while they are answering questions. In this study, all students were permitted to review the text while doing each activity, and some students were directed in their review to the exact section of text containing the answer (see Chapter II).

Effects of Questioning With Different Age and Ability Groups

Although college students may have reading and study strategies that are too well-formed to be amenable to manipulation by adjunct aids or questioning procedures (Anderson, 1979), the age group that has been most studied in adjunct-aid research is college students. The group next most studied is high-school students, and the group least studied is elementary or middle-school students (Anderson & Biddle, 1975; Hartley & Davies, 1976; Faw & Waller, 1976; Rickards & Denner, 1979). Most of the findings from research on adjunct aids have been based on the performance of older students, presumably with average or above-average reading ability.

Furthermore, the relatively few adjunct-aid studies in which data are divided according to students' ability have produced mixed findings: Rothkopf (1972), Shavelson and his associates (1974), and Rickards and Hatcher (1978) reported that students with low-level verbal ability, low incentive, low initial learning or poor comprehension benefit the most from being asked questions; Sanders (1973) found that students with high ability benefit the most; and Koran and Koran (1975) reported that students of low and high verbal ability benefit the same. The only conclusion that can be drawn is that more information is needed about the effects of adjunct aids on the comprehension of readers of specified ability levels. For this reason, the present study was designed to determine how forms of adjunct-aid assistance affect the comprehension of students with below-average reading ability.

Frequency of Questions

How often the text is interrupted by questions seems to be directly related to student performance on measures of comprehension following the questions (Rickards & DiVesta, 1974). Frase's (1968) investigation of the effects of question frequency on the comprehension of college students, replicated by Frase, Patrick and Schumer (1970), indicated that asking one question after every paragraph (approximately 200 words of text) is more effective than asking two questions after every two paragraphs, or three questions after every three paragraphs. Boyd (1973) supported the findings in his study, showing that questions placed after every paragraph increased retention of ideas more than questions placed after every five paragraphs. Although the frequency of the questions in these studies was confounded with the number of questions asked at any point, the findings set a research precedent and an interval of approximately 200 words between questions has been accepted by other researchers, for example, Hiller (1974).

However, definite conclusions about optimal frequency of questions cannot be drawn because the conditions among studies have varied greatly (Anderson & Biddle, 1975). Furthermore, the studies exploring frequency of questions are difficult to generalize from for the purposes of the present study because none of them have considered the possible effects of (1) using different types or difficulties of text, (2) separating the data for poor and good readers, (3) permitting the text to be reviewed following the questions, or (4) conducting studies with junior-high students.

The findings from research on the frequency of questions affected the design of the present study in that the activities are placed relatively close to the information at which they are directed. However, the number of activities was determined by the complexity of ideas rather than by the number of words, and the proximity of activities to the relevant pieces of text information depends on the location of the pieces of information necessary to make a text-required inference. The possible effect on students' comprehension of the distance between activities and text information was partially explored by giving some students graphic aid to help them locate the relevant text information (see Chapter II).

Type of Questions

The types of questions used in adjunct-aid studies have been given various labels such as: lower-order, literal, rote, verbatim, factual, higher-order, conceptual, application-to-new example, inferential, and meaningful. All these have been based on Bloom's (1956) taxonomy, according to which they are roughly classified into lower- and higher-order questions. Lower-order questions are designed to tap a reader's rote or verbatim level of learning; that is, the questions usually require only verbatim recall or recognition of the exact words from the text. Higher-order questions are designed to require the reader to understand what Carroll (1971) called "the substance or meaning of discourse" (p. 151). However, since there is no empirical evidence of differences in the effectiveness of lower- and higher-order questions, determining the cognitive level of questions according to taxonomies (Bloom, 1956; Sanders, 1966; Barrett, 1976; Elijah & Legenza, 1978) may not be a valid way to attack the problem of whether or not a question requires readers to process information in the text meaningfully. Research has not been conducted across or within studies using higher- and/or lower-order questions to determine how many of the questions function as labelled or how similar the definitions of higher- and lower-order questions are.

Research emphasis on type of question. The interspersed questions which were used in early (1965-70) research on adjunct aids were mainly lower-order questions. The early emphasis on lower-order, verbatim questions in studies has been criticized as not representative of the kind of learning students achieve when they read (Watts & Anderson, 1971; Carver, 1972; Richards & Denner, 1978). The predominance of lower-order questions may stem from investigators' attempts to write items that are of comparable difficulty and easy to score.

Since 1970, adjunct aid studies have focused on the effects of higher-order questions on text comprehension. Hunkins (1968) found that higher-order questions have a significantly better effect on the comprehension scores of sixth graders than lower-order questions.

However since then, results from studies comparing lower- and higher-order questions offer little guidance for designing adjunct aids. Rosenshine (1976) reviewed the literature on questioning and concluded that (1) the effects of higher-order questions have not been evident; (2) the effects of lower-order questions are not clear; and (3) a synthesis of the studies showed trends to suggest that lower-order questions are positively related to student achievement and higher-order questions are negatively related to student achievement.

The effects of higher-order questions may be masked because the instruments for assessing student comprehension measure mainly literal-level knowledge rather than higher levels of comprehension. Some evidence that this may be true comes from results of studies using free recall rather than objective tests as a measure of comprehension. A recent review of inserted questions concluded that "...it has been repeatedly demonstrated that high-level questions produce more and better organized recall of passage information than low-level (verbatim) questions" (Rickards & Denner, 1978, p. 331).

Type of question used in this study. The activities accompanying text in this study are similar to higher-order questions in that they were designed to invite readers to process text and derive meaning. Designing the activities so that readers are invited to process text meaningfully was a three-step process. First, the passage used in the study was analyzed by using a system of discourse analysis to determine where the information in the passage might predictably be misunderstood by readers (see The Use of Discourse Analysis section). Next, activities were worded in such a way that as much as possible of the processing of information was left up to the readers rather than being done for them in the activities. Third, the readers were sometimes required to answer a lower-level question that established a necessary literal fact before they were led on to make a text-connecting inference. Since the goal for the activities was to require readers to make inferences necessary for understanding the text, and since inferential reasoning is considered to involve higher-order thinking (Bloom, 1956; Frase, 1970), the activities on the whole function as higher-order rather than lower-order questions.

Summary: The Use of Adjunct Aids in the Study

Schooling has been and is based upon asking students questions, and the process and result of asking students questions about what they read has been investigated extensively. Results of these investigations show that answering questions improves comprehension. However, little is known except that adjunct-aid assistance improves comprehension. The questioning process is still similar to a home remedy for ailments: It works but the components that are helpful compared to those that are irrelevant or counter-productive have not been identified.

In this study, activities accompanied sections of expository text. These activities differed from traditional postquestions in that they sometimes (1) referred back to information in previously questioned sections, and (2) functioned like prequestions by focusing on information necessary for understanding the next section.

Results from research on postquestions may not generalize to classrooms for two reasons. First, in research studies, the position of questions in text has usually been controlled, whereas in classrooms students are usually free to read questions and text in whichever order they prefer. This study compared typical research and classroom procedures by giving some students activities and text simultaneously and giving others activities after an initial reading of text. Second, in the process of controlling the position of questions, studies have seldom permitted students to review text whereas classroom procedures encourage students to review while answering questions. In this study all students were encouraged to review text while doing the activities: Some were required to review the text generally in order to locate answers to the activities; others were required only to review the specific parts of the text which contained the answers.

Because relatively few studies have been done to examine the effects of adjunct aids on the comprehension of students with below-average reading ability, this study focused upon the performances of poor readers in the seventh grade.

The frequency of questions used in the study was determined by the location in the text of difficult inferences and the density of ideas rather than by the number of words between activities. The study was also designed to examine the effect on comprehension of providing readers assistance in locating the section of text to review in order to find the answer to a given activity.

The activities used in the study were comparable to what adjunct-aid research has labelled higher-order questions in that the activities were designed to invite the reader to process the information in the text.

Summary of the Rationale

The present study was conducted to gain information about the influence of written activities involving text-connecting inferences on the comprehension of poor readers. An analysis of the semantic structure of an expository passage (Kintsch, 1974) was used as a guide for constructing the activities and the post-tests. Activities to accompany the passage were designed to invite readers to make those inferences which appear to be essential to comprehension of the text. The inferences considered to be essential to comprehension were those: (1) based upon previous text information predicted by Kintsch's model to be no longer in working memory, (2) presented ambiguously in the passage according to the analysis of text, or (3) necessary for comprehension of forthcoming text information.

Studies on adjunct aids were examined for guidance in directing activities at inferences essential for comprehension of expository text. The results of these studies support the decision in the present study, to: (1) have activities follow sections of text, (2) encourage students to review text while doing activities, (3) examine the comprehension of poor readers, and (4) use activities that function as higher-order questions in that they invite students to process inferential text information.

Immediate and delayed post-tests over the content of the passage were administered in order to determine the effects on the comprehension of readers which were apparently caused by (1) controlling the placement of activities, and (2) giving students assistance in finding answers to the activities in the text. The placement of activities in text was controlled in order to discover if the classroom procedure of having workbook or textbook activities available along with text appears to affect retention of text information by below-average readers. Some of the readers had available the option of reading activities either before reading text or while reading the text for the first time, whereas others did not have this option and were presented with the activities only after an initial reading of text. Some readers were shown which part of the text to review in order to answer the activities.

Hypotheses

One global hypothesis was formulated in order to investigate the effects of inference-making aids on poor readers' comprehension:

Hypothesis 1: The immediate and delayed post-test scores of subjects who are presented with inference-making aids will be significantly higher than the immediate and delayed post-test scores of subjects who are not presented with inference-making aids.

Hypotheses 2 and 3

Two additional hypotheses were formulated, concerning the effect of the order in which inference-making aids and text were presented and the effect of giving graphic locational aid. The specific hypotheses were:

Hypothesis 2: The immediate and delayed post-test scores of subjects who are presented with inference-making aids after an initial reading of text will be significantly higher than the immediate and delayed post-test scores of subjects who are presented with inference-making aids simultaneously with text.

Hypothesis 3: The immediate and delayed post-test scores of subjects who are presented with inference-making aids accompanied by graphic locational aid will be significantly higher than the immediate and delayed post-test scores of subjects who are presented with inference-making aids without graphic locational aid.

In order to test these hypotheses, the performance of pairs of treatment groups were compared for each of the four tests: The performance of the two treatment groups which received graphic aid after an initial reading of text was compared with the two treatment groups which received graphic aid simultaneously with an initial reading of text in order to test Hypothesis 2. Similarly, the performance of the two treatment groups which received activities without graphic aid after an initial reading of text was compared with the two treatment groups which received activities without graphic aid simultaneously with an initial reading of text.

The effects of the four treatment conditions were further examined by comparing pairs of treatment groups against each control group (see Chapter II). In this way, the effect of activities with and without graphic aid and the effect of simultaneous as compared to subsequent presentation of activities and text were examined in more detail for each of the four tests.

Following the testing of the three hypotheses and the post hoc examination, the mean scores of each group were computed for the post-test items on the multiple-choice test which were (1) specifically related to the activities, and (2) completely unrelated to the activities. The same contrasts which had been carried out previously in the testing of the three hypotheses were then carried out for these new sets of mean scores.

CHAPTER II

METHOD

This study, conducted in April and May of 1980, was an examination of the immediate and delayed comprehension of expository text in six groups of seventh graders with below-average reading ability, according to their scores on a standardized reading test. In an attempt to facilitate retention of ideas in the text, students in four treatment groups were provided with written activities focused on places in the text where inference-making must occur. Students in two control groups were not provided with activities. Comprehension following treatment or control procedures was assessed by a battery of two tests administered immediately after the procedures and again two weeks later. Comparisons were made among the mean-score results of the tests in order to investigate differences in the results among combinations of treatment and control groups and between combinations of treatment groups.

Subjects

For the study, 132 subjects classified as poor readers were drawn at random from a population of 612 seventh graders available in three of the seven junior high schools in a city of 100,000 people located in Minnesota. The populations of the three junior high schools shared a predominately white, lower-middle-class socioeconomic background.

Altogether the students in 21 classrooms (8 from one junior high, 7 from another, and 6 from the other) participated in the study. In view of the likelihood that the populations of the junior highs were not identical, classrooms in at least two of the three junior highs were randomly assigned to each of the six treatment or control groups in the study. Two of the six groups read the text without doing activities: One of these groups read the text once; the other read and reread. Four of the six groups completed activities focused on selected places in the text where the reader must make an inference: Two of these groups received the activities and the text at the same time; the other two groups received the activities after an initial reading of the text. One group in each of the latter two sets of groups received graphic aid to help them locate answers in the text.

All students in the participating classrooms were given the opportunity to receive the materials and do the work; however, only the work done by students classified as poor readers and selected as subjects was analyzed for the purpose of the study. The subjects were classified as poor readers on the basis of their total scores in reading on the Comprehensive Test of Basic Skills (1973), expanded edition, form S2, which had been administered to them at the end of the sixth grade. The scores were obtained from records available at the school. Students whose scores were at or above a 6.8-grade level were considered above-average readers and were not classified as subjects. Students whose scores were below a 3.6-grade level were judged unable to decode the materials and were not classified as subjects. Students whose scores were at or above a 3.6-grade level and below a 6.8-grade level were considered to be below-average readers and were eligible to participate in the study.

The minimum number of poor readers identified in any of the six groups was 22. In the group containing only 22 poor readers, all 22 were classified as subjects. In those groups in which more than 22 possible subjects were available, a random selection of subjects was made from the pool of poor readers so that each of the six groups in the study were brought to a final size of 22.

Materials

Materials for the study included:

- A 1,300-word expository passage entitled "The Kalahari Desert" (Appendix A), revised from a unit in Life in Ecosystems (Wilkie, 1978).
- Four sets of inference-making activities: Two sets with identical activities accompanied with graphic aid to signal the location of answers in the passage but assembled differently; and two sets without graphic aid, identical but assembled differently (Appendix C).

- Two comprehension tests: a multiple-choice test and a recognition test (Appendix D).

The Passage

"The Kalahari Desert," a unit from Life in Ecosystems (Wilkie, 1978) which had already undergone revision since Wilkie first published it, was chosen for use in the study. It was then shortened to 1,300 words and further revised to improve its syntactic and semantic structures. The revision was read and edited by three doctoral students in reading and a staff member of the Reading Project at the University of Wisconsin, all of whom agreed the passage was grammatically correct and logically written. Next the passage was analyzed and activities were written. The activities were focused on places in the text where the analysis indicated that inference-making was required in order to comprehend the textual message. After the activities were written, three versions of the passage were prepared (Appendix A). Only the instructions to the reader varied among the three versions: One version, prepared for the two control groups, consisted of the text only; one version, prepared for the two treatment groups that received the passage and all the activities simultaneously, instructed students to do the sets of activities; the other version, prepared for the two treatment groups that received the sets of activities one-at-a-time after reading sections of text, instructed students when to go get each set.

A contrived text was used in the study instead of an actual passage from a textbook for two fundamental reasons: First, the contrived text permitted the choice of a relatively unknown topic, which might reduce the possible effect of prior knowledge on the results of the study. Underlying this reason is the assumption that differences in prior knowledge can be a strong influence on performance in follow-up comprehension tests. The other reason for using contrived text was to provide as logical a semantic structure and as correct a syntactic structure as possible. Text containing such logical and correct structures is easier to analyze than most textbook passages are. Furthermore, logical text should offer more inference-making guidance than less logical text offers, and, therefore, the contrived text used in this study may be a more rigorous test of the value of inference-making activities than uncontrived text would be.

Analysis of the Passage

The passage was analyzed by using Kintsch's (1974) system of discourse analysis. Ordinarily when a passage is analyzed by Kintsch's method, the levels of semantic importance are established by using free-recall data from readers. In this study, Kintsch's method was used without free-recall feedback, as a tool for analyzing text in order to design activities and test items more systematically than could be done otherwise.

Unfortunately, analyzing text using Kintsch's model, with or without free-recall feedback, involves subjective judgement because the model "is only concerned with the coherence of the text and does not care at all what is said" (Kintsch, 1979, p. 11). A nonsense word is handled by the model as easily as is a sensible word. Although recognition of nonsense words is no problem for an analyzer, assessment of the difficulty of the sensible words is a problem. Inference-making is required when a word concept requires explicit or implicit textual explanation. The model provides no guidelines for recognizing which words require such textual explanation and which do not. However, in this study the subjectivity involved in the use of Kintsch's system did not appear to destroy the validity of the analysis in that three other doctoral candidates who analyzed samples of the passage used in the study produced very similar propositional structures and inference identification.

The analysis of the passage (Appendix B) followed Turner and Greene's (1977) manual for using Kintsch's (1974) system. All propositions were: enclosed in parentheses, numbered sequentially, referred to by the most recent proposition number when they reappeared, marked with a > when they were inferred, and indented according to their level of importance in the text. The type of proposition was written in capital letters and was followed by a colon [illegible]g., Appendix B, #1-14). Also arguments which were not propositions were written in capital letters and were separated by commas (e.g., Appendix B, #1, 5, 11). The actual words of the text were often hyphenated and retained as arguments instead of using the synonymous single-word arguments traditional in case grammar analyses (e.g., Appendix B, #94: LEFT-STANDING rather than REMAINING, and #83: MOST-OF-THE TIME rather than USUALLY). This was done because the unaltered language of the passage proved convenient for writing activities and test items.

The analysis was shortened by collapsing multiple-argument adjectival concepts connected to minor details into single propositions [e.g., Appendix B, #270 (NUMBER OF: FEET-TALL, FOUR-AND-ONE-HALF) rather than:

#270 (QUALITY OF: > 269, 271)
#271 (NUMBER OF: FEET, 273)
#272 (NUMBER OF: HALF, ONE)
#273 (CONJUNCTION: FOUR, 272)].

The case slots of predicate propositions were labelled by initials (i.e., A, E, I, O, S, G, $ represent agent, experience, instrument, object, source, goal, and empty slot, respectively) only when the classification of the case was not necessarily apparent (e.g., Appendix B, #233).

In the analysis (Appendix B), the predicate proposition is written first, followed by its argument propositions and its internal connective propositions. Then all modifier propositions which are not arguments of the predicate proposition appear, finally followed by any propositions of connection which link propositions not embedded in other propositions (e.g., Appendix B, #14-23). Thus, this analysis follows Mathews' (1980) ordering rules, which this analyzer considers more logical than the order Turner and Greene (1977) suggested as one possibility for Kintsch's system. The final analysis is the same, using either procedure.

Although the boundaries of sentences do not affect the analysis of the propositions in the text, for convenience in locating information during the writing of activities and test items, single horizontal lines were placed after the last proposition of each sentence (e.g., Appendix B, #6, 11), and double horizontal lines were placed after the last proposition of each paragraph (e.g., Appendix B, #30, 83).

The completed analysis of the 1,300-word passage yielded 727 propositions, of which 164 were inferred propositions. A large majority of the inferred propositions (143) were reference predicate propositions (e.g., Appendix B, #>8, >18, >20, >25). The minority of 21 inferred propositions were mostly connective propositions of a time-of or location-of circumstance type (e.g., Appendix B, #>13, >114, >138, >140) but included at least one causal, contrastive, disjunctive, conditional, and purposive type of connective proposition as well as one nominal predicate proposition and one modifier proposition.

The Activities

In order to choose where in the passage to focus readers' attention by means of inference-making activities, the (1) density of propositions, (2) number of inferred propositions, and (3) quality of inferred propositions were considered. The density of propositions in the text ranged from 0.18 to 1.00 propositions per running centimeter of text. Chunking the text arbitrarily into ten 13-line sections and averaging the propositional density within each of the sections gives some indication of the variation in propositional density (Figure 1). Similarly, counting the inferred propositions in each of the ten

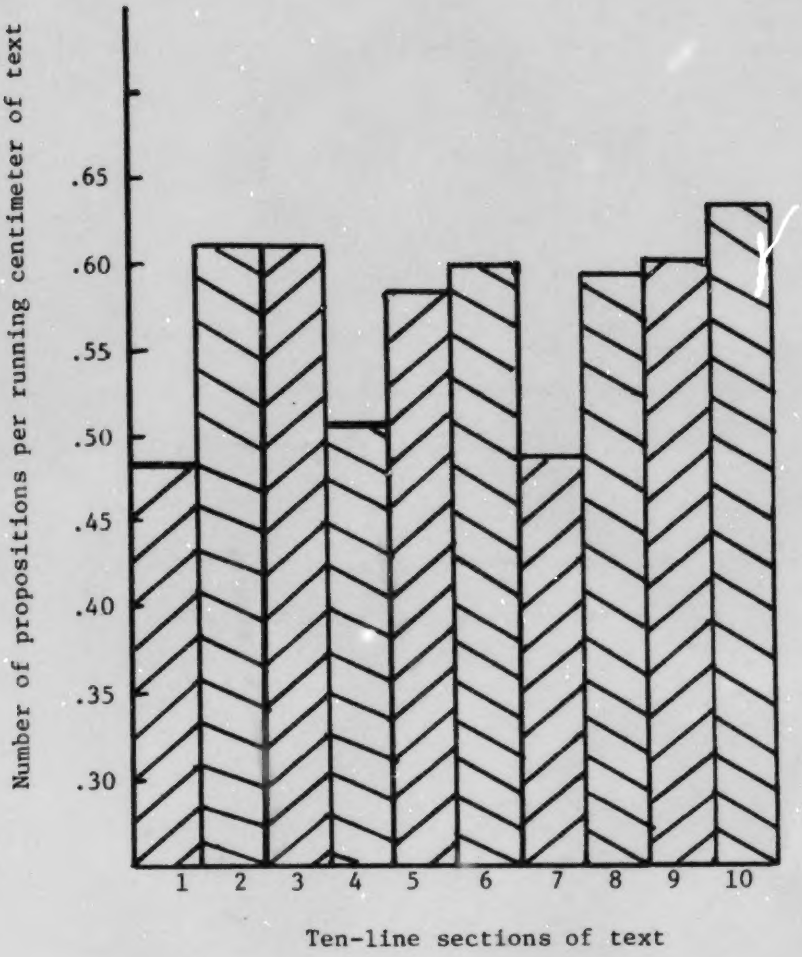

Figure 1. Average density of propositions in each 10-line section of the passage.

13-line sections indicates whether or not high propositional density was accompanied by a need for the reader to make inferences (Figure 2).

In order to be able to visualize the complexity pattern of the text as well as ascertain how far back the reader had to go to complete a reinstatement search, a coherence graph was constructed by drawing lines among all propositions that referred to each other (Appendix C). A list was then prepared of all the inferred propositions in the text. The list was matched against the propositions in the coherence graph to determine which of the inferred propositions: (1) were widely linked to other propositions, (2) required reinstatement searches, and/or (3) were necessary for understanding forthcoming textual information.

Next, the propositional density around each of the inferred propositions was taken into consideration. Finally, a subjective judgement was made about the difficulty of the semantic content with which the inferred propositions were involved. This judgement involved two intuitive assessments of the students' prior knowledge: whether the inferred propositions involved (1) vocabulary or use of vocabulary that the students had not experienced, and/or (2) information that contradicted what the students themselves had experienced to be true.

Then, the passage was divided into three sections and a set of activities was written for each section. The activities were designed to lead the reader to make inferences upon which understanding the text as a whole seemed to depend. Activities of this sort (Appendix C)

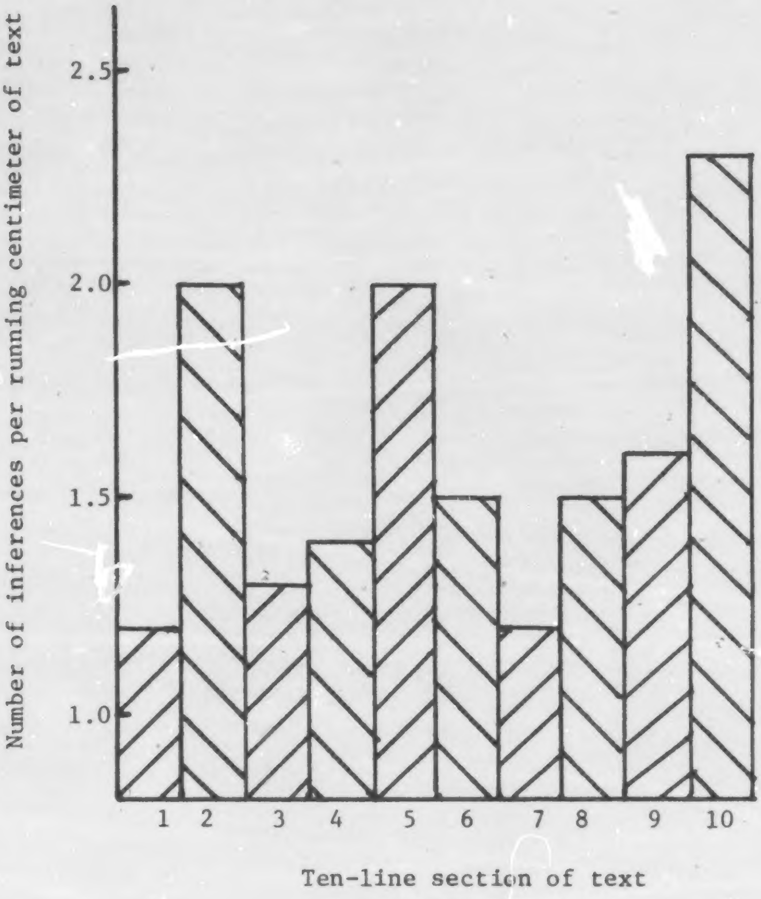

Figure 2. Average density of inferences in each 10-line section of the passage.

were received by two of the treatment groups in the study, NA and NS. One of the groups, NS, received the three sets of activities stapled into a single unit. The other group, NA, received the three sets of activities, stapled individually, one-at-a-time after sections of text.

Two other treatment groups, GA and GS, received the activities in a different form. The activities these groups received signalled the reader where to locate the answer in the text by means of brackets attached to the activities (Appendix C). This graphic locational aid was placed in the left margin of the activity sheets. The activity sheets were then stapled in the upper right corner so that the left edge of the activity sheets was free to be placed alongside the right side of the text as the students turned the activity pages and the text pages. The activity and text pages were lined up by matching the page number and dotted line on the left side of each activity sheet to the same page number and dotted line on the right side of each page of text (Appendices A and C). Likewise, one of the two treatment groups who received activities with graphic locational aid, GS, was given all three sets of activities stapled into a single unit. The other group, GA, was given the three sets of activities, stapled individually, one-at-a-time after sections of text.

The Comprehension Tests

A multiple-choice test and a recognition test (Appendix D) covering the content of the passage were constructed by using the information in the analysis of the semantic structure of the passage

(Appendix B). Prior to the study, the tests were administered to two groups of students to establish the validity of the tests and to permit the deletion of poor items. Two different types of test were used in the study in order to assess comprehension following treatment or control procedures in a more complete way than might have been achieved by using only one type of test.

Construction and Validation of the Tests

The comprehension tests were written by using the information in the analysis of the passage (Appendix B) to guide the construction of items. When the analysis yielded more than three levels of information, the finer-detail levels were collapsed to the third level (see Chapter I). Equal numbers of test items were then directed at each level. A pool of 70 multiple-choice items and 55 recognition items were generated. The items were checked against the list of propositions in the analysis of the passage and duplicate items that tapped the same propositional information were eliminated. Following criticism of the items by two doctoral candidates and a staff member of the Reading Project, all of whom were familiar with the content of the passage, some items were rewritten and others were eliminated. In particular, a number of items directed at the first level of information were eliminated because they were judged redundant. The multiple-choice test then contained 46 items. After similar editing, the recognition test contained 40 items.

Prior to the main data collection, two groups of eighth graders of varied reading ability who were available in one of the participating junior high schools took the battery of comprehension tests. Seventh graders, possibly of different socioeconomic backgrounds, were available in another city. However, students from the same population as the subjects in the study seemed preferable to students from another city, and students with possibly better reading ability might provide a more stringent, but no less valid, test of the validity of the tests than seventh graders.

The comprehension tests were administered to the two groups of students in order to ascertain that the battery: (1) could not be successfully completed by students who had not read the passage; (2) could be successfully completed by students who read the passage and had it available while taking the tests; and (3) contained items that had a variety of difficulty levels and tended to be answered correctly by the students who did well on the tests. Thirty-six students took the battery of tests without reading the passage. An item analysis of each student's results was used to determine which items were to be deleted because a group of students who had not read the passage consistently answered those items correctly. Thirty-four students read the passage and then took the battery of tests with the passage available. An item analysis of the results was used to determine which items were to be deleted because a group of students who had read the passage and had it available while taking the test consistently answered those items incorrectly. The item analysis of these students' results was also used to determine which items were to be deleted because they did not discriminate between students who did well on the tests and students who did poorly. The testing procedure took part of a classroom period for the group who did not read the passage and a full classroom period for the group who did read the passage.

A FORTAP program computer package (Appendix E) was run on the test results of each item for both groups. The group who took the tests without reading the passage had a mean score of 15.5 with a standard deviation of 5.3 on the 46-item multiple-choice test and a mean score of 20.8 with a standard deviation of 3.0 on the 40-item recognition test (Tables 1 and 2). Since random scores on the tests would have been 12.5 for the multiple-choice test and 20.0 for the recognition test and only one item on the multiple-choice test was answered correctly by more than 50 percent of the students, no items on the tests were deleted solely on the basis of the results of the item analysis of this group.

The performances of the groups on both versions of the comprehension tests is shown in Tables 1 and 2. The group who read the passage and then took the tests with the passage available, had a mean score of 27.8 with a standard deviation of 8.6 on the 46-item multiple-choice test and a mean score of 31.7 with a standard deviation of 5.0 on the 40-item recognition test. Hoyt reliability was .88 for the multiple-choice test and .77 for the recognition test. Based on the item analysis for this group, six multiple-choice items and five recognition items were deleted from the score results of the subjects in the study (see Appendix D). These were items that did not

TABLE 1

PERFORMANCES OF THE READ AND NO-READ GROUPS ON BOTH VERSIONS OF THE MULTIPLE-CHOICE TEST

Version	Group	Subjects	Items	Mean Score	Standard Deviation	Hoyt Reliability
Original	Read	34	46	27.7	8.6	.88
Revised	Read	34	40	23.8	8.1	.89
Original	No-Read	36	46	15.5	5.3	.66
Revised	No-Read	36	40	13.4	4.4	.56

TABLE 2

PERFORMANCES OF THE READ AND NO-READ GROUPS ON BOTH VERSIONS OF THE RECOGNITION TEST

Version	Group	Subjects	Items	Mean Score	Standard Deviation	Hoyt Reliability
Original	Read	34	40	31.7	5.0	.77
Revised	Read	34	35	27.5	5.0	.80
Original	No-Read	36	40	20.8	3.0	-.04
Revised	No-Read	36	35	17.9	2.9	.06

discriminate between students who did well on the tests and students who did poorly. However, a few items of poor discrimination were retained: These were items of high rather than low difficulty, which were closely related to the activities. The items were retained because they seemed likely to discriminate in the study between those who did activities and those who did not, and thereby permit students whose comprehension was aided by the activities to improve their scores.

After the tests were reduced to a 40-item multiple-choice test and a 35-item recognition test, an item analysis of the results of the two groups on the revised tests yielded (1) a mean of 13.4 with a standard deviation of 4.4 on the multiple-choice test for the group who did not read the passage and a mean of 23.8 with a standard deviation of 8.1 for the group who read the passage, and (2) a mean of 17.9 with a standard deviation of 3.0 on the recognition test for the group who did not read the passage and a mean of 27.5 with a standard deviation of 5.0 for the group who read the passage. The Hoyt reliabilities had improved to .89 on the multiple-choice test and .80 on the recognition test. A one-way analysis of variance was performed on these results by using a SPSS computer program package (Appendix E). The differences between the results of the two groups on each of the revised tests was significant at the $p < .001$ level (Tables 3 and 4).

Although the item analyses done through computer programs (Appendix E) were helpful to the process of improving the tests, they were not as helpful as the verification of the semantic content of

TABLE 3

ANALYSIS OF VARIANCE OF THE READ AND NO-READ GROUPS' SCORES ON THE REVISED MULTIPLE-CHOICE TEST

Source	df	SS	MS	F Ratio	Probability
Between Groups	1	1903.9	1903.9	45.6	<.001
Within Groups	68	2841.5	41.8		

TABLE 4

ANALYSIS OF VARIANCE OF THE READ AND NO-READ GROUPS' SCORES ON THE REVISED RECOGNITION TEST

Source	df	SS	MS	F Ratio	Probability
Between Groups	1	1615.8	1615.8	98.2	<.001
Within Groups	68	1119.2	16.5		

each test item against the list of propositions in the analysis of the passage (Appendix B). Since item analyses do not differentiate between whether this was a valid arithmetic test or a valid test on the Kalahari Desert, they were therefore insufficient in themselves for validating tests over the textual content.

The multiple-choice test. The multiple-choice test used to assess comprehension following treatment or control procedures in the study consisted of 40 stems. The stems were kept short, averaging five words each (Appendix D); each stem was followed by four choices. Only one of the choices was correct according to the information in the passage or according to further knowledge of the topic of the passage. Distractors such as "None of the above," "All of the above," and "A and B" were not used. An answer sheet was provided and students did not mark on the test booklet.

The information in the stems and the correct answers matched the information in the analysis of text (Appendix B). A comparison of test items and activities revealed that: (1) Nine of the test items were activity-specific, that is, the answers were specifically given or requested in one or more activities, and (2) Nine of the test items were activity-irrelevant, that is, the answers were completely unrelated to information given or requested in any activity. The activity-specific items and the activity-irrelevant items are indicated in Appendix C.

The recognition test. Although a multiple-choice test is an accepted method of assessing students' comprehension (Thorndike, 1969), it may put poor readers at a disadvantage because incorrect multiple-choice answers may be more seductive for poor readers than for good readers. Multiple-choice tests may lead poor readers away from memory of the knowledge they gained from reading because such tests are often written more in the language of the test writer than in the language of the passage or in whatever language is in the readers' heads. Therefore, a recognition test in which correct answers duplicated the wording of the passage was also used.

The use of a phrase-recognition test of the type designed for this study appears to be novel. Results from the test validation show that (1) a very high Hoyt reliability can be obtained for a recognition test of this sort, and (2) in the tryout of the tests the read group outperformed the no-read group by about the same margin on the recognition test as on the multiple-choice test. The validity of the recognition test as an approach to measuring comprehension is further commented upon in the discussion in Chapter III.

The recognition test used to assess comprehension following treatment or control procedures in the study consisted of a list of 35 phrases, broken into five groups (Appendix D). The test required recognition of verbatim phrases from the passage. The students' task was to circle the letters of the phrases that had occurred in the passages. No answer sheet was provided, and students marked on the test itself.

The correct answers were verbatim phrases from the passage and represented all three levels of information in the passage as established by the analysis of text (Appendix B). The incorrect phrases neither imitated the wording of the passage nor contained statements which were true according to the passage or according to further knowledge of the topic of the passage.

Procedure

Six groups followed a procedure requiring each group to participate for a partial or full period of classroom time on three to four different days. The time was allocated as follows:

- A maximum of two classroom periods on two consecutive days for treatment or control procedures.
- One classroom period two days after completion of treatment or control procedures for the battery of comprehension tests.
- One classroom period two weeks after completion of treatment or control procedures for a second administration of the battery of comprehension tests.

The procedures for the six groups were as follows:

- One treatment group read a section of the passage and then was given a set of activities to complete with the passage available. The procedure was repeated until all three sets of activities were completed. The average time on task for the procedure was 58 minutes. This group is referred to as the NA Group

(group to which activities with No graphic locational aid were administered After reading).

- Another treatment group read a section of the passage and then was given a set of activities marked with graphic locational aids to complete with the passage available. The procedure was repeated until all three sets of activities were completed. The average time on task for the procedure was 56 minutes. This group is referred to as the GA Group (group to which activities with Graphic locational aid were administered After reading).
- Another treatment group was given the passage and all the activities simultaneously and completed the activities with the passage available. The average time on task for the procedure was 55 minutes. This group is referred to as the NS Group (group to which activities with No graphic locational aid were administered Simultaneously with the passage).
- Another treatment group was given the passage and activities marked with graphic locational aid simultaneously with the passage. The activities were completed with the passage available. The average time on task for the procedure was 53 minutes. This group is referred to as the GS Group (group to which activities with Graphic locational aid were

administered Simultaneously with the passage).

- One control group read the passage without doing activities. The group was given no specific instructions as to how many times or how quickly the reading was to be done. No one in the group spent more than 16 minutes on task and the average time for the procedure was 9 minutes. This group is referred to as the C1 Group (Control group number 1).
- The other control group read and reread the passage without doing activities. The group read the passage at whatever speed they preferred for 10 minutes. Then they took a 5-6 minute break and repeated the procedure five times. The group completed its procedure after the four treatment groups completed theirs so that they could be given a total reading time that would approximate the average total time the treatment groups spent reading and doing activities. This group is referred to as the C2 Group (Control group number 2).

A graphic summary of the average amount of time spent on task by each group is given in Figure 3.

Data Analysis

A design with six orthogonal cells (Figure 4) was used to test three directional hypotheses (Figure 5). The dependent variable was

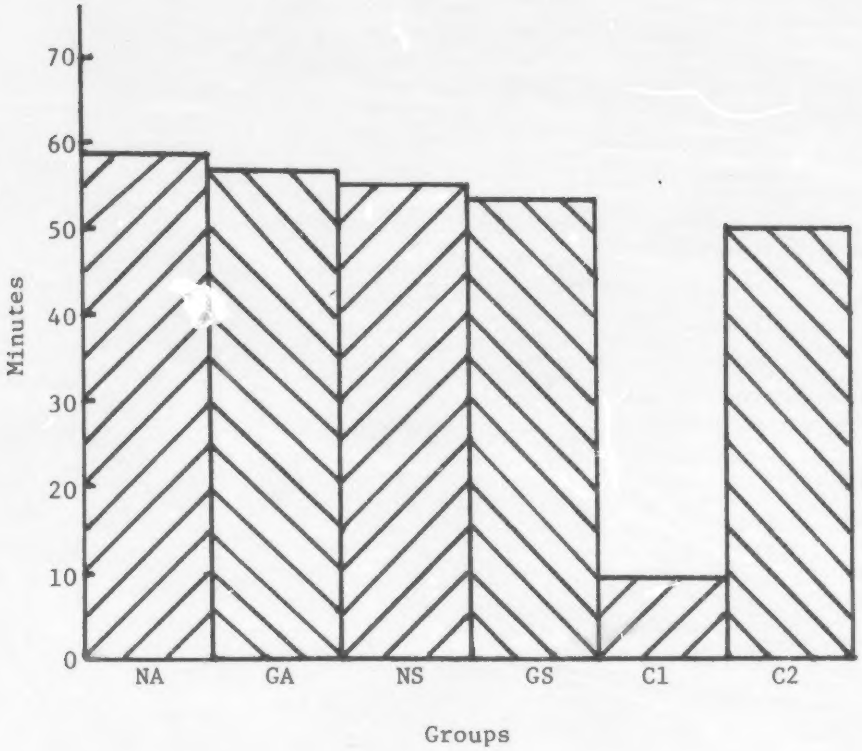

Figure 3. Average time consumed during treatment or control procedure.

Comprehension Tests	Treatment Groups				Control Groups	
Immediate Multiple-Choice	NA	GA	NS	GS	C1	C2
Delayed Multiple-Choice	NA	GA	NS	GS	C1	C2
Immediate Recognition	NA	GA	NS	GS	C1	C2
Delayed Recognition	NA	GA	NS	GS	C1	C2

N stands for doing activities with No graphic aid.
A stands for receiving activities After reading.
G stands for doing activities with Graphic aid.
S stands for receiving activities Simultaneously with text.
C1 stands for reading without doing activities.
C2 stands for reading and rereading without doing activities.

Figure 4. Design of the study.

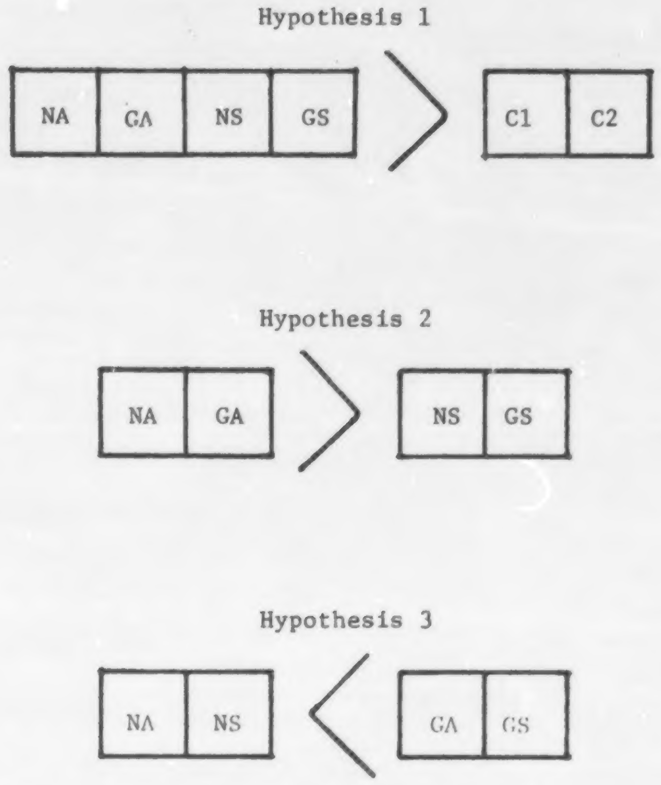
Hypothesis 1
NA
GA
NS
GS
C1
C2
Hypothesis 2
NA
GA
NS
GS
Hypothesis 3
NA
NS
GA
GS

Figure 5. Comparisons Used in Testing Hypotheses 1, 2, and 3.

the scores on the post-tests for each group. The scores for the two post-tests were considered separately, and the scores for the post-tests administered immediately after the treatment or control procedures were considered separately from the scores of the same post-tests administered two weeks later. Thus, in all, 24 sets of scores were involved in the three planned comparisons used to examine the data. The alpha level was set at $\underline{p} < .01$ for determining significance in all analyses for the study.

The three planned comparisons were made using the scores of the following cells: two treatment cells in which activities were presented simultaneously with text, one with graphic locational aid (GS) and one without (NS); two treatment cells in which activities were presented after an initial reading of text, one with graphic locational aid (GA) and one without (NA); and two control cells in which text was presented without activities, one in which text was read once (C1) and one in which text was read and reread for a period of time equal to the average total time consumed in the four treatment cells (C2). The comparisons were made by means of one-way analyses of variance performed by a SPSS program (Appendix E).

In one of the planned comparisons, testing Hypothesis 1 (Figure 5), the four treatment cells were contrasted with the two control cells in order to evaluate the totaleffect of the inference-making aids. In the other two planned comparisons, testing Hypotheses 2 and 3 (Figure 5), pairs of the treatment cells were compared with each other in two different ways in order to test the effect of the two independent variables: (1) order of the presentation of inference-making aids and text, and (2) presence or absence of graphic locational aid.

Following the test of the hypotheses, a post hoc examination of the data was conducted to compare the performance of various pairs of treatment groups with the performance of each of the control groups (Figure 6). Results were determined by Scheffé procedures.

A further examination of the hypotheses involved new sets of scores from the multiple-choice tests. One of the sets involved only the nine items which were specifically related to the activities. The other set involved only the nine items which were completely unrelated to information given or requested in the activities. The planned comparisons to test Hypotheses 1, 2, and 3 were repeated using the new sets of scores. Similar sets of activity-specific and activity-irrelevant scores from the recognition tests were not considered because the recognition test contained only five items in each of the categories.

Finally, a MINITAB program was constructed to accommodate the data from the study. This program was used to obtain correlations between the immediate and delayed tests, and between the multiple-choice and recognition tests. In addition, the graphic capabilities of the MINITAB program were used to provide a pictorial overview of some of the results.

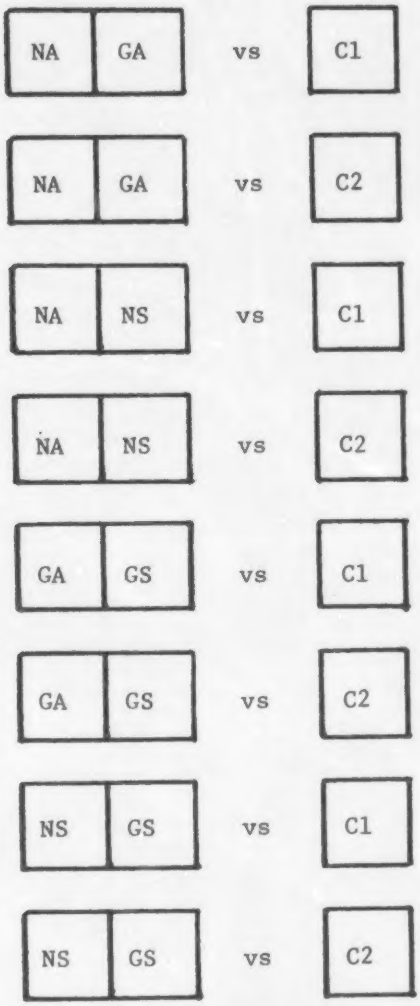
NA GA vs C1
NA GA vs C2
NA NS vs C1
NA NS vs C2
GA GS vs C1
GA GS vs C2
NS GS vs C1
NS GS vs C2

Figure 6. Scheffé comparisons.

CHAPTER III

RESULTS AND DISCUSSION

The purpose of the study was to compare the retention of ideas from expository text by students who did inference-making activities while they read and by students who read without doing activities. Retention of ideas was assessed by a multiple-choice test and a recognition test, which had been validated prior to the study (see Chapter II). Assessment involved comparisons among the mean scores on these tests from six groups. The assessment was made two days after completion of the treatment or control procedure and again two weeks after completion of the procedure. As a precaution against confounding results by combining them, (1) the results from the multiple-choice test and the recognition test were treated separately, and (2) the results of the immediate and the delayed administration of each test were treated separately.

Comparisons were made using the scores on the comprehension tests of the four treatment groups, NA, GA, NS, and GS, and the two control groups, C1 and C2. (These designations are explained in Chapter II.)

To provide an overview of the results, the mean scores on the comprehension tests are listed in Table 5. The results for the six groups on each of these assessment measures are presented visually in

TABLE 5

SUMMARY OF THE GROUPS' MEAN SCORES ON THE COMPREHENSION TESTS

Group	Comprehension Tests			
	Immediate Multiple-Choice	Delayed Multiple-Choice	Immediate Recognition	Delayed Recognition
NA	26.1	25.0	29.2	28.2
GA	27.0	23.0	28.0	27.1
NS	21.6	20.2	25.1	24.2
GS	18.5	17.8	22.3	22.4
C1	15.7	14.3	21.0	20.2
C2	19.5	17.3	24.0	22.1

Figures 7, 8, 9, and 10, which portray the means accompanied by their 95 percent confidence limits. The means, standard deviations, and standard errors for each group on each of the four tests are given in Tables 6, 7, 8, and 9. The mean scores for the treatment groups are rather low, as expected, because the subjects in the study were all poor readers.

Three hypotheses were developed to compare the differences among the groups as measured by their performance on each of the four assessment measures: the immediate multiple-choice test, the immediate recognition test, the delayed multiple-choice test, and the delayed recognition test. Following the major testing of the hypotheses by means of analysis of variance, the effect of graphic aid, and of simultaneous vs. sequential presentation of activities, was examined in more detail through Scheffé (1953) procedures. In addition, a narrow-scope examination of the three hypotheses was made by rerunning the analysis of variance program (Appendix E) using scores for each group based only on the items in the multiple-choice test which were (1) specifically related to the activities, and (2) completely unrelated to the activities.

Hypotheses

The one global hypothesis, Hypothesis 1, deals with the over-all effect of inference-making activities on comprehension. Hypothesis 1 states:

```
        +----------+----------+----------+----------+----------+----------+
NA                                                  I******I********I
GA                                                     I*******I*******I
NS                                 I*******I********I
GS                     I********I*******I
C1           I*******I********I
C2                            I******I*******I
        +----------+----------+----------+----------+----------+----------+
      12.0       15.0       18.0       21.0       24.0       27.0       30.0
```

Figure 7. Means and 95 percent confidence intervals from the scores of the six groups on the immediate multiple-choice test.

```
        +----------+----------+----------+----------+----------+----------+
NA                                        I********I*******I
GA                                    I*******I*******I
NS                          I******I*******I
GS                  I*******I*******I
C1       I*******I*******I
C2                 I******I********I
        +----------+----------+----------+----------+----------+----------+
      11.5       15.0       18.5       22.0       25.5       29.0       32.5
```

Figure 8. Means and 95 percent confidence intervals from the scores of the six groups on the immediate recognition test.

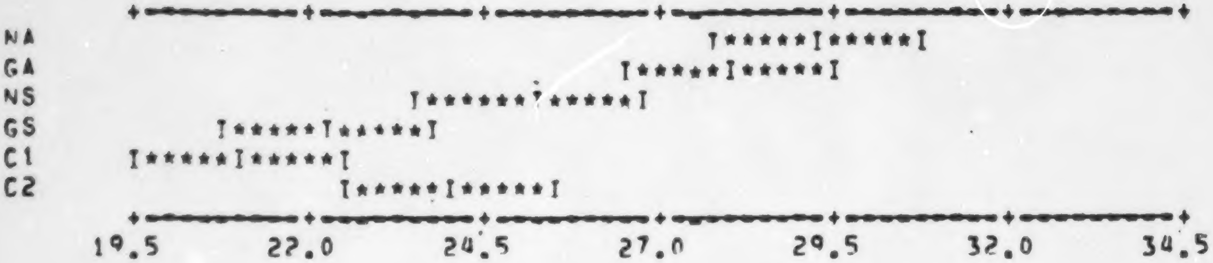

Figure 9. Means and 95 percent confidence intervals from the scores of the six groups on the delayed multiple-choice test.

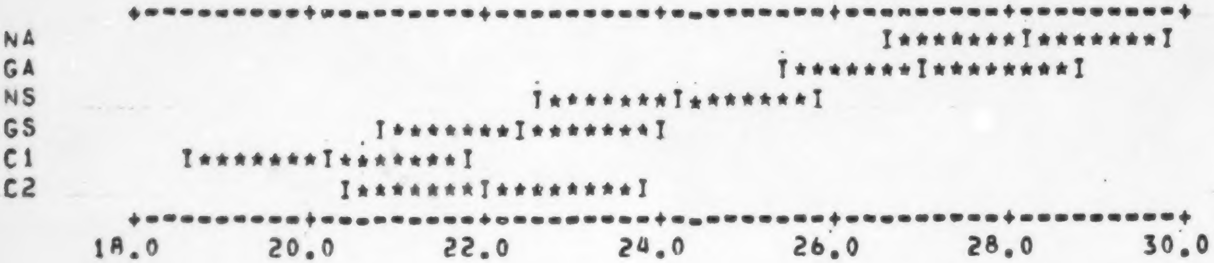

Figure 10. Means and 95 percent confidence intervals from the scores of the six groups on the delayed recognition test.

TABLE 6

PERFORMANCES OF THE SIX GROUPS ON THE IMMEDIATE MULTIPLE-CHOICE TEST

Group	Subjects	Mean Score*	Standard Deviation	Standard Error
NA	22	26.1	4.0	0.9
GA	22	27.0	4.8	1.0
NS	22	21.6	5.0	1.1
GS	22	18.5	4.5	1.0
C1	22	15.7	5.2	1.0
C2	22	19.5	7.3	1.6

*Possible score of 40.

TABLE 7

PERFORMANCES OF THE SIX GROUPS ON THE DELAYED MULTIPLE-CHOICE TEST

Group	Subjects	Mean Score*	Standard Deviation	Standard Error
NA	22	25.0	4.3	0.9
GA	22	23.0	7.5	1.6
NS	22	20.2	5.6	1.2
GS	22	17.8	5.5	1.2
C1	22	14.3	4.7	1.0
C2	22	17.3	7.1	1.5

*Possible score of 40.

TABLE 8

PERFORMANCES OF THE SIX GROUPS ON THE IMMEDIATE RECOGNITION TEST

Group	Subjects	Mean Score*	Standard Deviation	Standard Error
NA	22	29.2	3.3	0.7
GA	22	28.0	3.1	0.7
NS	22	25.1	3.1	0.7
GS	22	22.3	3.3	0.7
C1	22	21.0	3.5	0.8
C2	22	24.0	5.1	1.1

*Possible score of 35.

TABLE 9

PERFORMANCES OF THE SIX GROUPS ON THE DELAYED RECOGNITION TEST

Group	Subjects	Mean Score*	Standard Deviation	Standard Error
NA	22	28.2	3.8	0.8
GA	22	27.1	3.1	0.6
NS	22	24.2	4.1	0.9
GS	22	22.4	3.3	0.7
C1	22	20.2	3.5	0.8
C2	22	22.1	5.0	1.1

*Possible score of 35.

> The immediate and delayed post-test scores of subjects who are presented with inference-making aids will be significantly higher than the immediate and delayed post-test scores of subjects who are not presented with inference-making aids.

Hypothesis 2 concerns the order in which activities and text are presented. Hypothesis 2 states:

> The immediate and delayed post-test scores of subjects who are presented with inference-making aids after an initial reading of text will be significantly higher than the immediate and delayed post-test scores of subjects who are presented with inference-making aids simultaneously with text.

Hypothesis 3 deals with the presence or absence of graphic aid. Hypothesis 3 states:

> The immediate and delayed post-test scores of subjects who are presented with inference-making aids accompanied by graphic locational aid will be significantly higher than the immediate and delayed post-test scores of subjects who are presented with inference-making aids without graphic locational aid.

The criterion level for accepting the hypotheses was set at $p \leq .01$.

Analyses of Variance

One-way analyses of variance were carried out by means of an SPSS program (Appendix E) on the score results from the (1) immediate multiple-choice test, (2) delayed multiple-choice test, (3) immediate recognition test, and (4) delayed recognition test. The mean scores and F ratios from the analyses of variance are listed in Table 10. The F ratios are in each case well in excess of the critical value of 3.17. This critical value was set as that necessary for a $\underline{p} < .01$ level of significance, for the number of degrees of freedom involved in the study.

TABLE 10

MEAN SQUARES AND F RATIOS FROM ANALYSES OF VARIANCE FOR THE FOUR COMPREHENSION TESTS

	Between Groups			Within Groups	
Test	df	MS	F Ratio	df	MS
Immediate Multiple-Choice	5	433.7	15.68	126	27.7
Delayed Multiple-choice	5	341.2	9.83	126	34.7
Immediate Recognition	5	225.4	17.08	126	13.2
Delayed Recognition	5	209.0	14.04	126	14.9

Hypothesis 1

As explained in Chapter II, to test the first hypothesis, the scores of the four treatment groups were contrasted with the scores of the two control groups, for each of the four tests (Figure 5). The results of the analyses of variance for these contrasts appear in Table 11. In every case the treatment groups outperformed the controls, and the differences were significant at the probability level $p < .001$. Hypothesis 1 is therefore accepted.

TABLE 11

ANALYSIS OF VARIANCE OF THE COMPREHENSION TESTS: HYPOTHESIS 1*

Test	Value	S. Error	t Value	df	t Prob.
Immediate Multiple-Choice	5.7	1.0	5.9	126	<.001
Delayed Multiple-Choice	5.7	1.1	5.2	126	<.001
Immediate Recognition	3.6	.7	5.4	126	<.001
Delayed Recognition	4.3	.7	6.1	126	<.001

*Pooled-variance estimate.

The results of the testing of Hypothesis 1, although highly significant, present an undetailed finding which provides no indication of how the different conditions in the study affected the results. The analyses of variance simply indicate that the inference-making aids used in the study had an incontestably positive effect on each of the four measures of comprehension. More detailed findings were obtained in the testing of Hypotheses 2 and 3 and from the results of the Scheffé procedures.

Hypothesis 2

To test Hypothesis 2, the scores for the two groups, NA and GA, which received activities after reading the passage were contrasted with the scores for the two groups, NS and GS, which received the same activities simultaneously with the reading. Table 12 shows the results of the analysis of variance for this comparison. The t probabilities are <.001 for each of the tests. Hypothesis 2 is therefore accepted.

The strength of the empirical support from the data in this study for the acceptance of Hypothesis 2 is surprising, because some students in the groups (NS, GS) who were given the text and activities simultaneously were observed to follow the procedure required of the NA and GA groups by reading the text before looking at the activities. Furthermore, no students in the NA and GA groups were observed collecting a set of activities before reading the text. However, despite the observation that student behavior appeared to blur the potential differences in performance between the groups who received

TABLE 12

ANALYSIS OF VARIANCE OF THE COMPREHENSION TESTS: HYPOTHESIS 2*

Test	Value	S. Error	t Value	df	t Prob.
Immediate Multiple-Choice	6.5	1.1	5.8	126	<.001
Delayed Multiple-Choice	5.0	1.3	4.0	126	<.001
Immediate Recognition	4.9	.8	6.4	126	<.001
Delayed Recognition	4.3	.8	5.2	126	<.001

*Pooled-variance estimate.

the materials simultaneously and those who received them sequentially, the differences in performance between these groups were highly significant. The investigator has not been able to discover any phenomena in the study beyond order of presentation of activities and text to account for, or even influence, the superiority of the performance of the groups required to read text before receiving activities.

A possible explanation of the results is that when activities and text are presented simultaneously, many students, perceiving that the most important task is to complete the activities, may not attempt to comprehend the text or even to read all of it. Presentation of activities after the students have read the text may circumvent this undesirable effect, and aid comprehension by inviting further processing of textual information already gained from reading.

Hypothesis 3

To test Hypothesis 3, the performances of the two groups, NA and NS, which received no graphic locational aid were contrasted with the performances of the two groups, GA and GS, which received the graphic aid. The analysis of variance for this comparison is summarized in Table 13. The t probability for the immediate recognition test is $<.01$. The result from this one test is significant and suggests that the converse of the hypothesis is correct: That is, on this comprehension measure the groups which received no graphic aid performed significantly better than the groups which received graphic aid. On the other tests, although the groups without graphic aid outperformed the groups with graphic aid consistently, the differences are not statistically significant. On the basis of these results, Hypothesis 3 is decisively rejected.

The design of this study separated the effects of order and graphic locational aid from the overall effect of the inference-making aids. The results of the testing of Hypothesis 3 suggest that the presence of graphic locational aid with these inference-making activities not only did not aid comprehension but produced a slightly negative effect. This finding was further confirmed by examining the data through Scheffé procedures.

TABLE 13

ANALYSIS OF VARIANCE OF THE COMPREHENSION TESTS:
HYPOTHESIS 3*

Test	Value	S. Error	t Value	df	t Prob.
Immediate Multiple-Choice	1.1	1.1	1.0	126	.313
Delayed Multiple-Choice	2.2	1.3	1.7	126	.085
Immediate Recognition	2.0	.8	2.6	126	.010
Delayed Recognition	1.5	.8	1.8	126	.079

*Pooled-variance estimate.

Although this study was designed to examine the value of graphic locational aid and although the results of this study show that graphic locational aid was not a factor in the improved post-test performance of the subjects who did inference-making activities, possibly the true worth of graphic locational aid was not assessed in this study. Inference-making activities and contrived expository text may not be the type of materials with which readers benefit from such aid. Graphic locational aids may be helpful to readers in tasks where comprehension of the whole text is not of primary importance. For example, such aid may be valuable when requiring students to understand parts of a text is more feasible than requiring them to understand it all.

The GA and GS groups, respectively, averaged less time doing the activities than the NA and NS groups. Although the differences in time were not great (see Figure 3), directing the readers' attention to the exact portions of text which contain the answers to the activities may reduce the time the readers spend processing the text.

The oral responses which the investigator received from students and teachers in treatment-group classrooms and the levels of apparent industriousness in those classrooms, indicated that the activities with the aids were preferable to the activities without such aids.

Scheffé-Procedure Results

Scheffé (1953) procedures were used to compare the performance of each of the control groups, C1 and C2, with the performance of four separate pairs of treatment groups: (1) NA and GA, who received activities after an initial reading of text, (2) NS and GS, who received activities simultaneously with text, (3) GA and GS, who received activities with graphic locational aid, and (4) NA and NS, who received activities without graphic locational aid (Figure 6).

The Scheffé procedures were planned in order to reveal possible effects of the presence or absence of independent variables that might not have been visible in the testing of the hypotheses. In the light of the significant results in the testing of two of the hypotheses, the Scheffé procedures were not absolutely necessary. However, the results from the procedures in fact not only confirm but clarify the results of the testing of the three hypotheses in several ways. In the test of Hypothesis 1, the performances of the control groups were combined, whereas in the Scheffé procedures the performances of the control groups are examined separately. In the testing of Hypothesis 1, the performances of all treatment groups were combined, whereas in the Scheffé procedures related treatment groups were considered in pairs. In the testing of Hypotheses 2 and 3, the performances of different pairs of treatment groups were contrasted, while in the Scheffé procedure, pairs of treatment groups were compared with individual control groups.

The Effect of the Order in Which Text and Activities are Presented

The combined performances of the two groups, NA and GA, who received activities after an initial reading of text, were contrasted with the performances of each of the control groups, C1 and C2. The performance of the combined treatment group was significantly higher at the $p < .01$ level than the performance of the group, C1, who read the material without doing activities as well as the performance of the group, C2, who read and then reread the material for approximately as long as the treatment groups took to read and do activities. This finding held true under all eight testing conditions (Table 14). No other combination of treatment groups showed such a robust effect.

In contrast, although the combined performances of the two groups who received activities and text simultaneously, NS and GS, generally exceeded the performances of the C1 and the C2 groups, the

TABLE 14

COMPARISONS USING SCHEFFÉ PROCEDURE

	Multiple-Choice Test		Recognition Test	
Comparisons	Immediate	Delayed	Immediate	Delayed
NA,GA vs C1	10.85*	9.70*	7.60*	7.45*
NA,GA vs C2	7.05*	6.70*	4.60*	5.55*
NA,NS vs C1	8.15*	8.30*	6.15*	6.00*
NA,NS vs C2	4.35	5.30	3.15	4.10*
GA,GS vs C1	7.05*	6.10	4.15*	4.55*
GA,GS vs C2	3.25	3.10	1.15	2.65
NS,GS vs C1	4.35	4.70	2.70	3.10
NS,GS vs C2	0.55	1.70	-0.30	1.20
(Critical Value	5.47	6.13	3.58	4.01)

*Significant at the .01 level.

differences were not significant at the $p < .01$ level under any of the eight testing conditions. These findings support the decision in the study to accept Hypothesis 2.

The Effect of the Presence of Graphic Locational Aid

The combined performances of the two groups, GA and GS, who received graphic locational aid were contrasted with the performance of the C1 group and with the performance of the C2 group. The performance of the combined treatment group was significantly higher at the $p < .01$ level than the performance of the C1 group on all of the tests except the delayed multiple-choice test. Although the performance of this combined treatment group generally exceeded the performance of the C2 group, the differences were not significant at the $p < .01$ level under any of the four testing conditions (Table 14).

The combined performance of the groups who did not receive graphic locational aid, NA and NS, was similar to the performance of the combined treatment group who did receive the graphic aid. However, this group's performance was not only significantly higher at the $p < .01$ level than the performance of the C1 group on all the immediate and delayed tests, but this group's performance also exceeded the C2 group's performance at the $p < .01$ level of significance under one of the four testing conditions (Table 14). These findings generally support the decision in the study to reject Hypothesis 3.

Activity-Specific and Activity-Irrelevant Items

Analyses of variance were run on new sets of scores for the multiple-choice test using the SPSS program (Appendix E). The new sets of scores for each group were drawn from selected items on the tests. One set of items was composed only of items which were specifically related to the activities in that the information in each of the test items had been specifically given in, or requested in, one or more of the activities. The other set was composed of items which were irrelevant to the activities in that the information in each of these test items was not related to any information given in, or requested in, the activities. The multiple-choice test contained nine activity-specific items and nine activity-irrelevant items. New means, standard deviations and standard errors were calculated from each subject's answers to these items (Tables 15, 16, 17, 18). For these subtests containing only nine items each, the criterion level for accepting the hypotheses was set at $\underline{p} < .05$, in order to avoid making errors of Type II.

Results for Activity-Specific Items

The results from the analyses of variance of the groups' performances on the activity-specific items in the multiple-choice test supported the acceptance of Hypothesis 1 (Table 19). Since the results for the entire test indicate the value of activities, the results for the subtest containing only questions directly related to activities would be expected to show the same effect, so this result was anticipated. The results for the activity-specific test are also generally consistent in supporting Hypothesis 2 (Table 20). This result is also reasonable in that the beneficial effect of presenting activities after reading of text should apply particularly

TABLE 15

PERFORMANCES OF THE SIX GROUPS ON ACTIVITY-SPECIFIC ITEMS IN THE IMMEDIATE MULTIPLE-CHOICE TEST

Group	Subjects	Mean Score*	Standard Deviation	Standard Error
NA	22	6.82	1.56	.33
GA	22	7.09	1.11	.24
NS	22	5.68	1.96	.42
GS	22	5.36	2.01	.43
C1	22	3.73	1.98	.42
C2	22	4.14	2.14	.46

*Possible score of 9.

TABLE 16

PERFORMANCES OF THE SIX GROUPS ON ACTIVITY-SPECIFIC ITEMS IN THE DELAYED MULTIPLE-CHOICE TEST

Group	Subjects	Mean Score*	Standard Deviation	Standard Error
NA	22	6.50	1.59	.34
GA	22	5.95	2.01	.43
NS	22	5.80	1.81	.39
GS	22	4.77	2.18	.46
C1	22	2.64	1.53	.33
C2	22	3.73	1.93	.41

*Possible score of 9.

TABLE 17

PERFORMANCES OF THE SIX GROUPS ON ACTIVITY-IRRELEVANT ITEMS IN THE IMMEDIATE MULTIPLE-CHOICE TEST

Group	Subjects	Mean Score*	Standard Deviation	Standard Error
NA	22	6.18	1.44	.30
CA	22	5.86	1.83	.39
NS	22	4.82	1.87	.40
GS	22	3.41	1.30	.28
C1	22	3.86	1.61	.34
C2	22	4.64	2.30	.49

*Possible score of 9.

TABLE 18

PERFORMANCES OF THE SIX GROUPS ON ACTIVITY-IRRELEVANT ITEMS IN THE DELAYED MULTIPLE-CHOICE TEST

Group	Subjects	Mean Score*	Standard Deviation	Standard Error
NA	22	6.05	1.50	.32
GA	22	5.05	2.40	.51
NS	22	4.95	1.99	.42
GS	22	3.64	1.43	.31
C1	22	3.50	1.68	.36
C2	22	4.31	2.40	.51

*Possible score of 9.

TABLE 19

ANALYSIS OF VARIANCE OF THE ACTIVITY-SPECIFIC ITEMS IN THE TESTS: HYPOTHESIS 1*

Test	Value	S. Error	t Value	df	t Prob.
Immediate Multiple-Choice	2.307	.338	6.828	126	<.001
Delayed Multiple-Choice	2.591	.343	7.558	126	<.001

*Pooled-variance estimate.

TABLE 20

ANALYSIS OF VARIANCE OF THE ACTIVITY-SPECIFIC ITEMS IN THE TESTS: HYPOTHESIS 2*

Test	Value	S. Error	t Value	df	t Prob.
Immediate Multiple-Choice	1.432	.390	3.670	126	<.001
Delayed Multiple-Choice	.909	.396	2.297	126	.023

*Pooled-variance estimate.

strongly to the activity-related items. The analyses of variance results for the test of Hypothesis 3 using the activity-specific items are consistent with the results for the entire test in that Hypothesis 3 is rejected (Table 21).

TABLE 21

ANALYSIS OF VARIANCE OF THE ACTIVITY-SPECIFIC ITEMS
IN THE TESTS: HYPOTHESIS 3*

Test	Value	S. Error	t Value	df	t Prob.
Immediate Multiple-Choice	.023	.390	.058	126	.954
Delayed Multiple-Choice	.818	.396	2.067	126	.041

*Pooled-variance estimate.

Results of Activity-Irrelevant Items

The results from the analyses of variance for the performances on the activity-irrelevant items are of particular interest. The comparisons summarized in Table 22 indicate that Hypothesis 1 is supported for the activity-irrelevant test items. Therefore, the inference-making activities seem to aid comprehension even on these items. Likewise the comparisons in Table 23 indicate that for comprehension of activity-irrelevant textual ideas, it is important to

TABLE 22

ANALYSIS OF VARIANCE OF THE ACTIVITY-IRRELEVANT ITEMS IN THE TESTS: HYPOTHESIS 1*

Test	Value	S. Error	t Value	df	t Prob.
Immediate Multiple-Choice	.818	.324	2.53	126	.013
Delayed Multiple-Choice	1.011	.358	2.823	126	.006

*Pooled-variance estimate.

TABLE 23

ANALYSIS OF VARIANCE OF THE ACTIVITY-IRRELEVANT ITEMS IN THE TESTS: HYPOTHESIS 2*

Test	Value	S. Error	t Value	df	t Prob.
Immediate Multiple-Choice	1.909	.374	5.10	126	<.001
Delayed Multiple-Choice	1.250	.414	3.02	126	.003

*Pooled-variance estimate.

have the activities presented after text is read rather than simultaneously. Both of these comparisons suggest that processing inspired by the activities improves comprehension of text material unrelated to the activities, and so may foster incidental learning.

The analysis of variance of the activity-irrelevant items for Hypothesis 3 showed that even for activity-irrelevant items students who did not receive graphic locational aid were at an advantage over students who did (Table 24).

TABLE 24

ANALYSIS OF VARIANCE OF THE ACTIVITY-IRRELEVANT ITEMS IN THE TESTS: HYPOTHESIS 3*

Test	Value	S. Error	t Value	df	t Prob.
Immediate Multiple-Choice	.864	.374	2.31	126	.023
Delayed Multiple-Choice	1.159	.414	2.80	126	.006

*Pooled-variance estimate.

Correlations Among Measures of Comprehension

Four measures of comprehension were used to assess the retention of ideas from the passage. A multiple-choice test and a recognition test were administered immediately after the treatment or control procedures and again two weeks later. The correlations between the results of the immediate and delayed battery of tests and the correlation between the multiple-choice test and the recognition test are of interest and are considered in this section.

Correlations Between Immediate and Delayed-test Results

An overview of the mean scores from each of the groups on the four comprehension tests (Table 5) shows a pattern of decreasing mean scores from the immediate to the delayed post-tests. Most of the groups' scores show a moderately strong positive correlation between the scores on the tests administered immediately and those administered after a delay. Scores in the four treatment groups had Pearson product-moment correlation coefficients of 0.55 to 0.73, between the immediate and delayed test scores (Table 25). For these groups, the correlation between the immediate and delayed scores is about the same for the multiple-choice test and the recognition test.

The two control groups also showed a moderately strong positive correlation between the immediate and delayed test scores for the multiple-choice test (Table 25). For these groups, the correlation between the immediate and delayed scores for the recognition test was weaker (0.31, 0.42) but still positive. Since the control groups performed only slightly better than chance on the recognition test, recognition of verbatim phrases from the text appears somewhat more difficult than selection of correct answers on a multiple-choice test for subjects who do not do the activities

TABLE 25

PEARSON PRODUCT-MOMENT CORRELATIONS BETWEEN PERFORMANCE ON IMMEDIATE AND DELAYED TESTS

Group	Multiple-Choice Test	Recognition Test
NA	.689	.680
GA	.555	.727
NS	.590	.550
GS	.711	.594
C1	.655	.415
C2	.819	.308

Correlation Between Multiple-Choice Test and Recognition-Test Results

The use of a recognition test of the type written for this study as a measure of comprehension seems to be unprecedented. The overall pattern of results lends some credence to the validity of the recognition test. Data in the tables of the analyses of variance and Scheffé procedures show that among the treatment and control groups, the results on the multiple-choice and recognition tests are very similar (Tables 6-9). If either test had been used alone, the findings regarding the three hypotheses would have been identical.

The correlations between the scores on the multiple-choice test and the recognition test, summarized in Table 26, are of special

TABLE 26

PEARSON PRODUCT-MOMENT CORRELATIONS BETWEEN MULTIPLE CHOICE AND RECOGNITION TESTS

Group	Immediate Tests	Delayed Tests
NA	.510	.483
GA	.467	.539
NS	.538	.612
GS	.292	.421
C1	.265	.634
C2	.611	.681

interest in connection with the question of validity. As a visual example, the correlation plot for the NA group on the delayed tests is shown in Figure 11. The scores from the NA, GA, and NS groups show moderate positive correlations. The Pearson product-moment correlations between the multiple-choice and recognition tests for these groups range from 0.47 to 0.61. The scores for the GS group, which performed the poorest of the treatment groups, show a weaker but still positive correlation. The scores for the control groups also show moderate positive correlations in three of the four instances (see Table 26).

The moderate positive correlations between the multiple-choice and the recognition-test scores are reassuring because they indicate

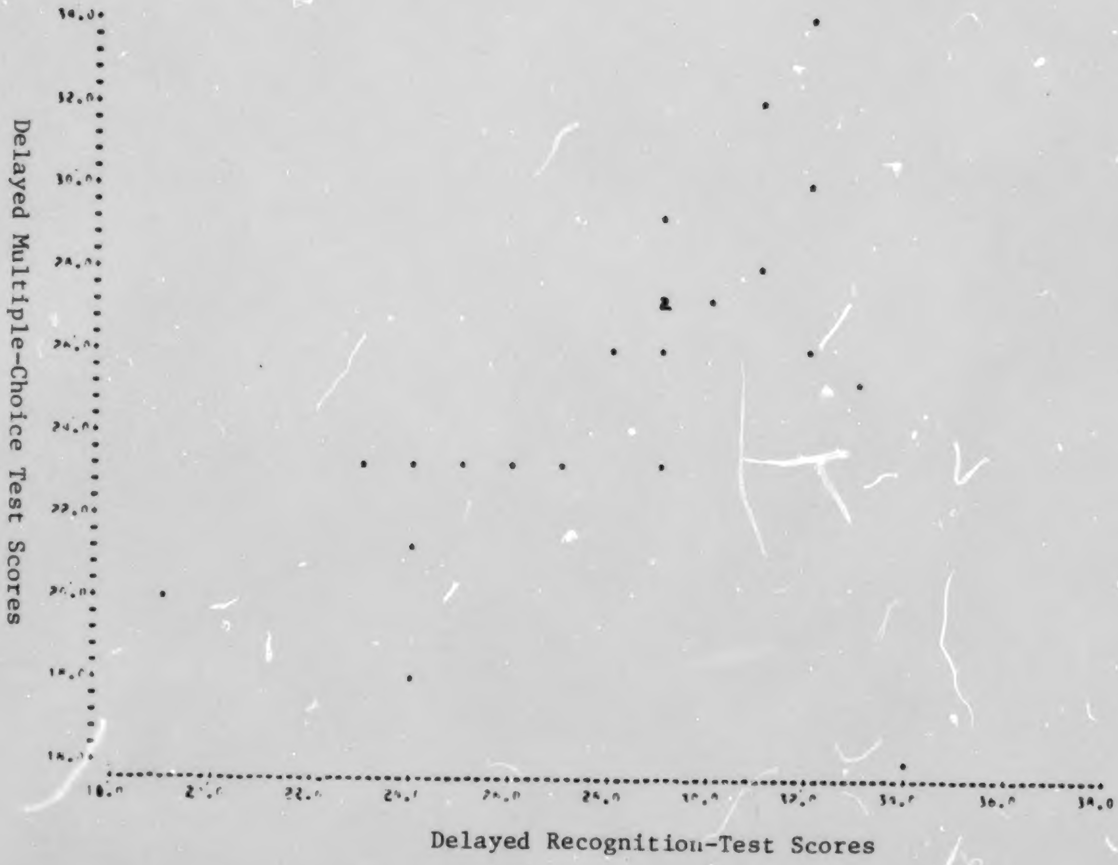

Figure 11. Plot of correlation between test scores on the delayed multiple-choice and the delayed recognition tests for the NA group.

that the two tests are measuring different, but related, things. Very high positive correlations between scores on the two tests would suggest that the tests were measuring the same factors and were therefore redundant. On the other hand, zero or negative correlations would show, contrary to the implicit hypothesis, that the two tests were measuring totally unrelated factors.

The pattern of results from treatment is that the NA, GA, and NS groups decisively outperform the controls (see Table 5) on both the multiple-choice and the recognition test. These results become even more striking in view of the correlations (Table 26) which indicate that the two tests are measuring related, but not identical, abilities.

Summary

In this study the performances of combinations of treatment groups who read and did inference-making activities were compared (1) against two control groups, and (2) among themselves. Performances were measured by comprehension tests given immediately after treatment or control procedure and again two weeks later. The scores from the tests were calculated for the six groups, and the results were used to test three hypotheses by analyses of variance.

Based on the results of the analyses of variance, two of the hypotheses were accepted: (1) the global hypothesis which stated that on all comprehension tests the combined performance of the treatment groups would be significantly better than the combined performance of the control groups, and (2) the hypothesis which stated that on all comprehension tests the performance of the treatment groups who received inference-making activities after reading would be significantly better than the performance of the treatment groups who received inference-making activities simultaneously with text. The third hypothesis, which stated that on all comprehension tests the performance of the treatment groups who received graphic locational aid would be significantly better than the performance of the treatment groups who did not, was rejected.

Scheffé procedures comparing the performances of combinations of treatment groups with the performance of individual control groups confirmed and clarified the results of the testing of the hypotheses.

The analyses of variance were rerun on new sets of scores composed of only the activity-specific and the activity-irrelevant items from the immediate and delayed administrations of the multiple-choice test. Results from 9 of these 12 analyses of variance were similar to the results of the analyses of variance for the complete version of the test.

Pearson product-moment correlations were determined between the performances on the immediate and delayed tests, and between the performances on the multiple-choice and recognition tests. Generally, moderately high positive correlations were found.

CHAPTER IV

SUMMARY, LIMITATIONS, CONCLUSIONS AND IMPLICATIONS

A summary followed by the general limitations of the study is provided as a background for the conclusions which appear to be warranted from the results of the study. Each conclusion is accompanied by its specific limitations and applications. In addition, some general implications for future research are suggested.

Summary

The purpose of the study was to investigate the effect on comprehension of (1) controlling the order in which inference-making activities and expository text are presented, and (2) embellishing the inference-making activities with graphic signals to indicate the location in the text of the answers. The rationale for the study drew upon research on discourse analysis, inference-making, and adjunct aids. Kintsch's (1974) system of discourse analysis was used as a guide for the writing of (1) activities that led the reader through the semantic structure of the text, and (2) test items that fit the semantic structure of the text. The choice of focusing the activities on places where the reader needed to make an inference was supported by results of research on the role of inference-making in comprehension. Results from research on adjunct aids were used as guidelines for: (1) placement of activities in respect to text, (2) frequency of activities, (3) type of activities, and (4) choice of age and reading-ability level of subjects.

Three hypotheses, concerning the effect that doing the activities would have on subsequent performance on the test items, were posed. The data for testing the hypotheses were collected from a study conducted with six groups of poor readers in the seventh grade. Four of the groups were treatment groups: the GA group, who received activities with graphic locational aid after an initial reading of text; the NA group, who received activities without graphic aid after an initial reading of text; the GS group, who received activities with graphic aid simultaneously with text; and the NS group, who received activities without graphic aid simultaneously with text. Two of the groups were control groups: the C1 group, who did not receive activities and read for as long as they preferred; and the C2 group, who did not receive activities but who read for approximately as long as the average time the treatment groups spent reading and doing activities.

The materials for the study consisted of a 1,300 word expository passage (Appendix A), four versions of the activities (Appendix C), and two comprehension tests (Appendix D), which were validated prior to the study. Each of the six treatment or control procedures took 1-2 periods of classroom time and were followed two days later, and again two weeks later, by the battery of two comprehension tests. The mean scores from the two immediate and two delayed comprehension tests were used to compare performances among the six groups. In the test for Hypothesis 1, the analyses of variance of the combined performance of the treatment groups (NA, GA, NS, GS) and the combined performance of the control groups (C1, C2) showed that the treatment groups outperformed the control groups at a $\underline{p} < .001$ level of significance (Table 11). In the test for Hypothesis 2, the analyses of variance of the performances of the pair of treatment groups who received activities after an initial reading of text (NA, GA) and the pair of treatment groups who received activities and text simultaneously (NS, GS) showed that the NA, GA groups outperformed the NS, GS groups at a $\underline{p} < .001$ level of significance (Table 12). In the test for Hypothesis 3, the analyses of variance of the pair of treatment groups who received graphic locational aid (GA, GS) and the pair of treatment groups who did not receive graphic locational aid (NA, NS) showed no significant differences (Table 13). Hypotheses 1 and 2 were accepted. Hypothesis 3 was rejected.

The data used in the testing of the three hypotheses were examined in more detail by using Scheffé procedures to compare various pairs of treatment groups with each of the control groups (Table 14). The results of the Scheffé procedures generally support the t-test results which led to the acceptance of Hypotheses 1 and 2 and the rejection of Hypothesis 3. The results of the Scheffé procedures concur with the conclusion that inference-making adjunct aids presented after reading, rather than simultaneously with reading, are most effective in increasing comprehension.

Further analyses of variance were carried out for scores on subtests containing only (1) items specifically related to the activities, and (2) items irrelevant to the activities. As anticipated, the results for the activity-specific items paralleled those for the entire test, in that the comparisons supported the acceptance of Hypotheses 1 and 2, and the rejection of Hypothesis 3. More surprisingly, the results for the activity-irrelevant items were also significant, and consistent with the complete test in supporting Hypotheses 1 and 2 and rejecting Hypothesis 3. These findings imply that activities have a beneficial effect on comprehension even of text unrelated to the activities.

Limitations

The conclusions as well as the implications for the classroom and for future research that can be drawn from the findings in this study are necessarily constrained by the limitations in the study. An overall limitation of the study is that it is purported to measure comprehension, although in this study comprehension is implicitly defined as whatever is measured by the tests administered after the treatment or control procedures. As in any study involving testing, the conclusions are therefore dependent upon the nature of the tests.

Subjects

The subjects were from a population of lower-middle-class, predominately white, seventh graders in the northern midwest of America. All subjects had below-average total scores in reading on the Comprehensive Test of Basic Skills. Therefore, generalizations about students based on data from subjects in this study should be limited by the particular characteristics of the subjects in this sample.

Materials

Any conclusions about the data in the study must be limited to conclusions based on the specific materials that were used. The passage (Appendix A) was a short, contrived, expository-style passage deliberately rewritten to be [illegible] and grammatically logical; comparisons were not made between this passage and typical classroom expository passages. The activities (Appendix C) and test items (Appendix D) were based on an analysis of the passage (Appendix B) based on Kintsch's (1974) system, but their construction also involved a continuous process of subjective judgement. Since the study involved comparing the effect of two types of inference-making activities and the order of their presentation with text rather than comparing types of students or types of student-teacher interactions, the limitations of the materials used in the study are particularly important.

Design and Procedures

Two limitations may have affected the randomization of the sample. The choice of subjects had to be made from among the 612 seventh graders available to the study who were present for both the immediate and delayed comprehension tests. The other limitation on the choice of subjects was the necessity of administering the same procedure to whole classrooms despite the variations in classroom sizes (17 to 29) and irrespective of the number of poor readers in each classroom. Consequently the sample size of 22 represented all of the students classified as poor readers available in one of the six conditions and 22 randomly selected from a pool of 24 to 31 in the other conditions.

Because the number of students available to the study was limited, the criterion upon which the classification of poor readers was based included some students who might equally well be classified as average readers. This limitation on the classification of poor readers is compounded because the aptitude measure upon which the classification was based may be inaccurate for two reasons. (1) The test itself may be a poor measure of reading ability or have been wrongly administered, scored, or recorded. (2) An assumption was made that the students who were poor readers at the time of testing were still poor readers at the time the study was conducted.

The study had three procedural limitations. First, although control of whether students received text and materials simultaneously (NS, GS) or sequentially (NA, GA) was accomplished through administrative devices, no control was exercised over whether students in the NS and GS groups (1) first read text and then read activities, or (2) read all or some of the activities before or as they read the text.

Another procedural limitation was that no attempt was made to determine the relationship between performance on the activities and performance on the tests. On the activities, some of the subjects skipped many answers, wrote "I don't know" for many of their answers, or were inattentive during the treatment. The degree to which these students were aided by doing activities compared with those students who completed the activities successfully is unknown.

Conclusions

The first conclusion that can be drawn from the study comes from the acceptance of Hypothesis 1. The conclusion is that the combined performance of poor readers who do the particular activities created for this study, irrespective of the order in which activities and text are presented or whether or not activities include graphic locational aid, will be significantly better than the combined performance of poor readers who read the text without doing the particular activities created for this study. The conclusion holds true irrespective of whether the text is read for as long as students choose when simply instructed to read it or read and reread for approximately as long as the average total time consumed by the students who do activities.

This is a global conclusion which suggests that inference-making activities can be a valuable aid in increasing comprehension.

The second conclusion is that the order in which text and activities are presented has a significant effect on subsequent comprehension of text in poor readers. Poor readers who are presented with inference-making activities after an initial reading of text do significantly better on subsequent comprehension tests than poor readers who have the activities presented simultaneously with the text.

The study provided no evidence to indicate that graphic locational aid improves comprehension. The subjects who did not receive such aid with the inference-making activities generally performed better than those who did, but the difference was significant in only one of the four comprehension tests (see Table 13). It can be concluded that graphic locational aid accompanying inference-making activities does not seem to aid comprehension.

Implications for Classroom Practice

The findings in the study have several implications for classroom practice. First, the overall finding that doing inference-making activities aided the comprehension of the subjects implies that the use of such adjunct aids may be valuable in the classroom, at least for poor readers. The highly significant results obtained with the materials used in this study further suggest that it may be worthwhile to concentrate in the classroom on places in expository materials where readers are required to make inferences.

The finding that the activities were more beneficial to the subjects' comprehension when presented after the text was read, rather than simultaneously, also has implications for teaching. Activities designed to be completed after text is read are a common form of classroom adjunct aid found in workbooks that accompany text and after the ends of sections of textbooks. However, it would appear from the data in this study that when poor readers have access to activities before they read text, they comprehend less of the text than when they are required to read text first. This suggests that activities designed to function as post-questions should not be in textbooks where students have ready access to them and that workbooks which amplify a text should be kept where students do not have access to them until the text has been read.

The finding that graphic locational aid is not beneficial, and, if anything, may reduce comprehension, suggests that classroom activities do not need to include graphic locational aid, and may be more effective without it. However, this researcher hesitates to dismiss graphic locational aid without further research because graphic locational aid appears to have considerable appeal for students and teachers. The apparent popularity and possible spread of classroom use of activities with graphic locational aid adds to the desirability of conducting additional research to establish whether this device is useful or is only an attractive gimmick.

Implications for Research

Further research is needed to verify as well as refine the findings in this study. A number of future studies seem to be in order. First, this study should be replicated with good readers as subjects. When information about the value of inference-making activities to good readers is obtained, the findings in this study could be generalized for application in classrooms with students of varied reading ability. If the facilitative effect of inference-making activities is not shown to occur with good readers, further research should be conducted with good readers using difficult materials which challenge the readers. Possibly, difficult materials put good readers in a position similar to poor readers because the need for inference-making activities is dependent on the difficulty level of the materials and not on the reading ability of the students. Future studies could determine if this is so.

Secondly, studies are needed to discover the generality of the finding that activities presented after students have read text are more beneficial to comprehension than activities presented with text. It seems important to find out if this conclusion is valid beyond the limits of this study. Replications of the study could be done using other types of text and other types of activities.

In addition, it would be useful to know if the finding that presentation of activities after students have read text is advantageous would be reversed for activities designed to function as prequestions. Some of the subjects who were presented with text and activities simultaneously were observed to read the text before looking at the activities. Possibly, some students always read text first when both text and questions are available. A study similar to the present study could be conducted to compare the effect of prequestions on comprehension when (1) questions and text are presented simultaneously, and (2) questions are presented before text.

Information is also needed about the relationship between students' performance on inference-making activities accompanying text and their subsequent performance on post-tests over the content of the text. Although the present study produced evidence that comprehension of expository text as measured by performance on post-tests was significantly improved after students did inference-making activities, no consideration was given in the study to how the students performed on the activities. However, classroom implications from this study depend upon whether or not the post-test performances of students (1) who did activities were significantly superior to the post-test performances of students who did not do activities irrespective of how adequately the activities were done, and (2) who received activities after an initial reading of text were superior to the post-test performances of students who received text and activities simultaneously, irrespective of how adequately the activities were done.

Next, studies should be designed to narrow the limitations of the present study. Since the study was largely concerned with types of materials rather than with types of student or student-teacher interaction, the limitations imposed by the particular passage, activities, and test items used in this study should be carefully examined.

In order to determine if the methodology behind the creation of the activities and the test items is an idiosyncratic interpretation by one investigator, the same design, passage, and guidelines might be used to create alternate sets of test items and inference-making activities. If this were done without knowledge of the test items and activities used in the present study and similar results were produced, the methodology behind the study could be affirmed.

Similarly, in order to determine if the results of the study were idiosyncratic to the particular passage used, the study could be replicated using a variety of passages. Such studies could determine if inference-making activities are useful with (1) uncontrived text, (2) longer passages, (3) a variety of content-area subjects, and/or (4) narrative prose.

The necessity of the time-consuming process of using a system of discourse analysis needs to be explored. Research could establish whether less or more care should be taken with a discourse analysis of text. Studies could be designed to investigate whether results similar to the results in this study occur when an analysis of a passage and the creation of test items and inference-making activities are done (1) less formally than in the present study, for example, by using outlining, common sense, and intuition; and (2) more formally than in the present study, for example, by using free-recall protocols from students to verify the text analysis and by using other systems of discourse analysis.

The student variable in this study could be investigated by conducting studies with students of varied ages and reading skills. For example, research could determine if students benefit more from inference-making activities in one content-area than in another and if English-second-language students benefit from doing similar inference-making activities. Moreover, in such studies, reading ability could be determined by other criteria than the total reading scores on the _Comprehensive Test of Basic Skills_ used in this study, and comprehension assessed by other criteria than multiple-choice and recognition tests.

In the present study, students were presented with relatively brief, self-explanatory materials and given no feedback. Any variables connected to student-teacher interaction were therefore eliminated. However, the expectation that students perform identically with and without interaction seems unrealistic since typical classroom procedures normally include interaction and feedback. In further studies, variables involving the interaction among students and teachers could be explored.

Without future research, applications of the results of this study to classroom techniques may be premature. This was a broad-stroke-design study, and now finer-grained studies are needed to reveal exactly which factors contributed to the study's success, which were neutral, and which, if any, were counterproductive. The study was not designed to yield evidence about how or why students did what they did. Consequently, although the results of the study are highly encouraging, exactly what to be encouraged about has not yet been determined.

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APPENDIX A

PASSAGE

APPENDIX A

Passage

Explanation:

The control groups, C1 and C2, received the passage with extra spaces on pages 2 and 4. In these spaces and in the space on page 6 at the end of the passage, instructions were printed for the treatment groups, NA, GA, NS, and GS. These instructions told the students in groups NS and GS when to do the appropriate activity sheet and told the students in groups NA and GA when to get the appropriate activity sheet.

The dashes after the page numbers on the right side of each passage page line up with the numbers on the left side of each page of the activities with graphic locational aid (see Appendix C).

(Passage for control groups C1 and C2)

THE KALAHARI DESERT

In southwestern Africa there is a great stretch of dry land. The land is flat with no lakes or rivers. Vegetation is scarce. The plants and animals that live here have adapted to an environment with little water and high temperatures. This land is the Kalahari Desert. The Kalahari Desert covers part of three nations of southern Africa.

The plants of the Kalahari have adapted to the desert environment. Most of these plants are grasses and bushes. However, every now and then across the barren desert a huge, 200-foot baobab tree is seen. Its great, thick branches reach like stretching arms into the sky. The bark is thick and smooth, and sags in folds toward the bottom of the tree. The tree is adapted to the hot, dry climate because it is able to store water in the spongy wood of its huge trunk. Some of the other desert plants store water in large underground roots. Many rest as seeds until the rainy season. The seeds cannot germinate without water, but, when the rain falls, the seeds can finally sprout.

The desert is without rain for almost 10 months of the year. A hot, dry wind blows across the desert most of the time. During the two cool months, June and July, the bushes and grass are covered with frost at dawn. Any water left standing freezes at night. Days warm slowly to around 80 degrees, but the cold returns at night.

Rains come at last to the Kalahari in December, January, and February. At this time, holes in the ground fill with water, and small ponds form. All of the desert life becomes active with the coming of the rains. The grass turns green, and new leaves and blossoms appear on the bushes. Flowering plants add bright colors to the desert scene. Much of the plant life sprouts from seeds that have rested while waiting for moisture. The plants bud, blossom, and bear their seeds quickly, for the season is short. The animals of the Kalahari graze on the new, tender plants brought to life by the long-awaited rains.

In March the drought, or dry time, returns. When the rains stop, the water holes start to dry up. They become slippery mud and then caked white earth. By June only little water holes which are deep in the ground and covered with long grass are left. These water holes are miles apart, and travel in the desert is nearly impossible when the water holes completely dry up in August.

To adapt to the desert environment, the animals, like plants, face the task of finding and storing water. Some desert animals seek a drink or store water in surprising places. Lizards and insects often lap dew at daybreak. Dew is tiny drops of water formed at night when it is cool. Desert tortoises carry extra body water around with them in two sacs under their upper shell. These sacs serve as two canteens for the tortoises. Many birds, such as the ostrich, and grass eaters, such as the antelope, travel across the desert to water holes. When times are very dry they often seek water outside the desert.

The Kalahari Desert is the home of people called Bushmen. The Bushmen are rather small people. As adults, they are four and one-half to just over five-feet tall. These people once lived on the rich grasslands of South Africa. In a struggle with cattle-raising peoples for the grasslands, the Bushmen were driven north. They found safety on the Kalahari, and as a hunting and gathering people still live as the earliest people on earth once did.

Because of the harsh desert conditions, the Bushmen do not plant crops or herd animals. Instead, they gather roots, berries, and nuts, and hunt animals. When the water holes in one place are dry and little food remains, the Bushmen must move to a new place. In their search for food and water, these people must move a great deal. They do not stay in one spot, but migrate from place to place. Such people are called nomads.

Where food and water can be found, a band of about 20 Bushmen set up a werf, which is their word for camp. A visitor could probably walk through the werf without knowing it because the small, cone-shaped houses made of sticks and grass look much like bushes. The Bushmen live in these skerms, which give them shade during the day and shelter from the cool winds at night. Near the houses is a carefully placed row of ostrich eggshells, often decorated with carved designs of zigzags and diamonds, or animal pictures. The eggshells are important because they hold water. Each one is filled through a hole cut in the shell. The hole is then stopped up with grass.

The main task of desert survival is finding food and water. The Bushmen know the land well. When the water holes dry up, the Bushmen must search for new sources of water. A Bushman can find water where no one else would think to look. He might walk a few feet to a little bush and pull out a tsama melon. He would make a hole in the top, mash the insides with a stick, and then drink the good juice. Other plants such as the bi and ga roots and the wild cucumber may be eaten for their juice. Another way a Bushman can get water is from sip wells. In some places, rain water is held in the moist sand. The water is three to four feet from the surface. He digs into the sand with a reed, which is a kind of grass with a hollow stem like a drinking straw. He sucks water through the reed and then stores the water in an ostrich eggshell. The Bushman works hard to get this necessity for survival.

The women and children gather fruit and nuts. Meat makes up only a small part of the food that the Bushmen eat. The Bushmen cannot always depend on animals as they can on plants. Over 100 kinds of plants are gathered for food. These include roots, bulbs, berries, other fruits, nuts, and leafy greens. The most important of these food plants is the mongongo nut. Mongongo nuts are a major part of the Bushman diet.

Early each morning, some of the women and children go to gather plants. The sun is not yet up, but it is already hot on the Kalahari. Some mornings, they have to walk many miles over the dry grass before they find anything. A digging stick, usually a tall, pointed branch, is used by the women. With this, they break the sunbaked earth and free the roots or plants to be gathered. Back at the werf, a shallow wooden bowl, called a stamping block, is used to mash seeds and nuts.

Early in the morning, the hunters are busy too. They must prepare their arrows before they go. First, the hunters file iron pieces into points for arrowheads. The arrowheads are carefully tied onto split sticks and then smeared with a poison that will kill the animals. This poison is made from bark or roots and the dried insect larvae of the ngoa moth. Sometimes, the venom of the deadly snake, the mamba, is used. The arrows are stuck, points upward, into the sand until the poison dries. The men are now ready for the hunt.

Antelopes and other large animals are regularly hunted with poisoned arrows. The Bushmen hunt smaller animals in other ways. Sometimes they dig into the underground burrows of animals like the springhares. The hunters hook the animal with a metal hook that is attached to a long pole. Then they dig up the soft sand to capture it.

Another animal that is hunted for food is the big leopard tortoise. This tortoise weighs up to eight pounds. It is easily caught by men, women, or children. The tortoise is baked in the shell and can feed a family of four.

The Bushmen do not wander across the whole desert alone. To survive, they live together in small bands. Each band has its territory, which includes a water hole and a vast stretch of land around it. Each band must ask permission to cross another band's territory. When a band moves, it goes to another place in its own territory.

Arranging the land into territories helps create order in a hunting and gathering culture. The people of the band know their territory well. The hunters know where game can be found in certain seasons and times of the day. In dry times, they know where to look for sip wells. Remembering where a green plant grew during the rainy season, Bushmen know where to look for food at a later time. They find the dried-up leaves of the plant and dig into the ground for its roots.

Page
2--

(Sample page from the passage for treatment groups NS and GS)

blossoms appear on the bushes. Flowering plants add bright colors to the desert scene. Much of the plant life sprouts from seeds that have rested while waiting for moisture. The plants bud, blossom, and bear their seeds quickly, for the season is short. The animals of the Kalahari graze on the new, tender plants brought to life by the long-awaited rains.

In March the drought, or dry time, returns. When the rains stop, the water holes start to dry up. They become slippery mud and then caked white earth. By June only little water holes which are deep in the ground and covered with long grass are left. These water holes are miles apart, and travel in the desert is nearly impossible when the water holes completely dry up in August.

To adapt to the desert environment, the animals, like plants, face the task of finding and storing water. Some desert animals seek a drink or store water in surprising places. Lizards and insects often lap dew at daybreak. Dew is tiny drops of water formed at night when it is cool. Desert tortoises carry extra body water around with them in two sacs under their upper shell. These sacs serve as two canteens for the tortoises. Many birds, such as the ostrich, and grass eaters, such as the antelope, travel across the desert to water holes. When times are very dry they often seek water outside the desert.

---------------- DO ACTIVITY SHEET A ----------------

The Kalahari Desert is the home of people called Bushmen. The Bushmen are rather small people. As adults, they are four and one-half

(Sample page from the passage for treatment groups NA and GA)

no one else would think to look. He might walk a few feet to a little bush and pull out a tsama melon. He would make a hole in the top, mash the insides with a stick, and then drink the good juice. Other plants such as the bi and ga roots and the wild cucumber may be eaten for their juice. Another way a Bushman can get water is from sip wells. In some places, rain water is held in the moist sand. The water is three to four feet from the surface. He digs into the sand with a reed, which is a kind of grass with a hollow stem like a drinking straw. He sucks water through the reed and then stores the water in an ostrich eggshell. The Bushman works hard to get this necessity for survival.

--------------- GET ACTIVITY SHEET B ---------------

The women and children gather fruit and nuts. Meat makes up only a small part of the food that the Bushmen eat. The Bushmen cannot always depend on animals as they can on plants. Over 100 kinds of plants are gathered for food. These include roots, bulbs, berries, other fruits, nuts, and leafy greens. The most important of these food plants is the mongongo nut. Mongongo nuts are a major part of the Bushman diet.

Early each morning, some of the women and children go to gather plants. The sun is not yet up, but it is already hot on the Kalahari. Some mornings, they have to walk many miles over the dry grass before they find anything. A digging stick, usually a tall, pointed branch, is used by the women. With this, they break the sunbaked earth and free the roots or plants to be gathered. Back at the werf, a shallow

APPENDIX B

TEXT ANALYSIS AND SAMPLE PAGES OF THE COHERENCE GRAPH

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1 (ISA:  KALAHARI, DESERT
    2 (PART OF: AFRICA, 3)
        3 (QUALITY OF: 4, DRY)
        4 (EXTENT OF: LAND, 5)
        5 (QUALITY OF: STRETCH, GREAT)
        6 (LOCATION OF, IN: 2, SOUTHWESTERN)

    ____

    7 (QUALITY OF: >8, FLAT)
       >8 (REF: THIS-LAND, 2)
    9 (PART OF: >8, 10)
        10 (NUMBER OF: 11, NONE)
        11 (CONJUNCTION: LAKES, RIVERS)

    ____

    12 (13, SCARCE)
       >13 (LOCATION OF, IN: VEGETATION, 2)

    ____

    14 (ADAPT-TO: 17, 20)
        15 (LIVE, PLANTS, >18)
        16 (LIVE, ANIMALS, >18)
            17 (CONJUNCTION: 15, 16)
           >18 (REF: HERE, 2)
        19 (QUALITY OF: >20, 23)
           >20 (REF: ENVIRONMENT, 2)
            21 (EXTENT OF: WATER, LITTLE)
            22 (QUALITY OF TEMPERATURE, HIGH)
                23 (CONJUNCTION: 21, 22)

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24 (ISA: 25, 1)

>25 (REF: THIS-LAND, 2)

26 (COVER, 1, 30)

27 (PART OF: AFRICA, SOUTHERN)

28 (NUMBER OF: 29, THREE)

29 (SOME OF: NATIONS, PART-OF)

30 (LOCATION OF, IN: 28, 27)

31 (ADAPT-TO, 15, >31a)

>31a (REF: DESERT ENVIRONMENT, 20)

32 (IDA: 33, 35)

33 (NUMBER OF: >34, MOST)

>34 (REF: THESE-PLANTS, 15)

35 (CONJUNCTION: GRASSES, BUSHES)

36 (SEE, $, 38)

37 (QUALIFY: 36, EVERY-NOW-AND-THEN)

38 (QUALITY OF: 39, HUGE)

39 (EXTENT OF: 40, TWO-HUNDRED-FOOT)

40 (LOCATION OF, IN: BAOBAB-TREE, 41)

41 (QUALITY OF: >42, BARREN)

>42 (REF: DESERT, 24)

43 (CONCESSION, HOWEVER: 32, 36)

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44 (REACH-INTO, 48, SKY)
      45 (QUALIFY: 44, 46)
            46 (MANNER OF: 47)
                   47 (QUALITY OF: ARMS, STRETCHING)
      48 (QUALITY OF >49, 50)
           >49 (REF: ITS-BRANCHES, 38)
            50 (CONJUNCTION: GREAT, THICK)
-------
51 (PART OF: >38, 52)
      52 (QUALITY OF: BARK, 53)
            53 (CONJUNCTION: THICK, SMOOTH)
54 (SAG, >52, G: 56)
      55 (QUALIFY: 54, IN-FOLDS)
      56 (PART OF: >38, BOTTOM)
      57 (CONJUNCTION: 51, 54)
-------
58 (ADAPT-TO, >59, >60)
     >59 (REF: TREE, 38)
     >60 (REF: HOT-DRY-CLIMATE, 20)
61 (STORE, >62, WATER, 63)
     >62 (REF: ITS, 38)
      63 (QUALITY OF: 64, SPONGY)
      64 (LOCATION OF, IN: WOOD, 65)
            65 (QUALITY OF: TRUNK, HUGE)
      66 (CAUSALITY: 58, 61)
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67 (STORE, >68, O: WATER, G:70)
    >68 (REF: 69, 14)
     69 (SOME OF: PLANTS, SOME-OTHER)
     70 (LOCATION OF: 71, UNDERGROUND)
          71 (QUALITY OF: ROOTS, LARGE)

72 (REST, >73, S: SEEDS)
    >73 (REF: MANY, 15)
     74 (TIME OF, UNTIL: 72, 75)
          75 (EXTENT OF RAIN, SEASON)

76 (GERMINATE, >77)
    >77 (REF: SEEDS, 72)
    >78 (CONDITION, UNLESS: 76, WATER)
79 (SPROUT, >77)
     80 (QUALIFY: 79, FINALLY)
81 (FALL, RAIN)
     82 (CAUSALITY, WHEN: 79, 81)
     83 (CONCESSION, BUT: >78, 82)

84 (COME, RAIN, >86)
     85 (NEGATE: 84)
    >86 (REF: DESERT, 24)
     87 (TIME OF: 84, 88)
          88 (NUMBER OF: MONTHS, 89)
          89 (EXTENT OF: TEN, ALMOST)
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90 (BLOW, 92, $, G: >94)

    91 (QUALIFY: 90, MOST-OF-THE-TIME)

    92 (QUALITY OF: WIND, 93)

        93 (CONJUNCTION:  HOT, DRY)

   >94 (REF: DESERT, 24)

______

95 (COVER, FROST, >96)

   >96 (REF: BUSHES-AND-GRASSES, 32)

    97 (TIME OF, AT: 95, DAWN)

        98 (TIME OF, DURING: 97, 99)

            99 (QUALITY OF: 100, COOL)

            100 (NUMBER OF: >101, TWO)

               >101 (REF: MONTHS, 102)

                    102 (CONJUNCTION: JUNE, JULY)

______

103 (>103a, $, 104)

   >103a (REF, FREEZE, FROST)

    104 (NUMBER OF: 105, ANY)

        105 (EXTENT OF: WATER, LEFT-STANDING)

    106 (TIME OF, AT: 103, NIGHT)

______

107 (WARM-TO, $, DAYS, G: 109)

    108 (QUALIFY 107: SLOWLY)

    109 (NUMBER OF DEGREES, 110)

        110 (EXTENT OF: EIGHTY, AROUND)

111 (RETURN, COLD)

    112 (TIME OF, AT: 111, NIGHT)
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     113 (CONCESSION, BUT: 107, 112)
    >114 (LOCATION OF, IN: 113, 24)
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115 (COME, RAINS, >117)
     116 (QUALIFY:115, AT-LAST)
    >117 (REF: KALAHARI, 24)
     118 (TIME OF: 115, 119)
          119 (CONJUNCTION: DECEMBER, JANUARY, FEBRUARY)
    >120 (REF: 115, 75)
____________
121 (FILL, WATER, 122)
     122 (LOCATION OF, IN: HOLES, GROUND)
123 (FORM, $, 124)
     124 (QUALITY OF:PONDS, SMALL)
     125 (TIME OF:121, >126)
    >126 REF: AT-THIS-TIME, 115)
     127 (CONJUNCTION: 121, 123)
____________
128 (MAKES, >129, O:>130, G:ACTIVE)
    >129 (REF: RAIN, 115)
    >130 (REF: 131, 24)
          131 (EXTENT OF: DESERT-LIFE, ALL)
____________
132 (TURN, GRASS, GREEN)
133 (APPEAR, 134, G;>136)
     134 (QUALITY OF:135, NEW)
          135 (CONJUNCTION: LEAVES, BLOSSOMS)
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>136 (LOCATION OF, IN: BUSHES, 24)

137 (CONJUNCTION: 132, 133)

>138 (TIME OF: 137, 115)

139 (ADD, 141, 142, 143)

>140 (TIME OF: 139, 115)

141 (QUALITY OF: PLANTS, FLOWERING)

142 (QUALITY OF: COLOR, BRIGHT)

143 (LOCATION OF, IN: SCENE, >144)

>144 (REF: DESERT, 24)

145 (SPROUT, 146, 149)

146 (EXTENT OF: >72, MUCH)

147 (REST, SEED)

148 (WAIT, SEED, WATER)

149 (CAUSALITY, WHILE: 147, 148)

>150 (REF: 149, 83)

151 (BUD, >152)

>152 (REF: PLANTS, 145)

153 (BLOSSOM, >152)

154 (BEAR, >152, SEEDS)

155 (CONJUNCTION: 151, 153, 154)

156 (QUALIFY: 155, QUICKLY)

157 (QUALITY OF: >158, SHORT)

>158 (REF: SEASON, 115)

159 (CAUSALITY, FOR: 156, 157)

160 (GRAZE-ON, 161, 166)
- 161 (LOCATION OF, IN: ANIMALS, >162)
  - >162 (REF: KALAHARI, 24)
  - 163 (QUALITY OF: >164, 165)
    - >164 (REF: PLANTS, 156)
    - 165 (CONJUNCTION: NEW, TENDER)
- 166 (BRING, 167, 168, LIFE)
  - >167 (REF: 168, 115)
  - 168 (QUALITY OF: RAIN, LONG-AWAITED)

169 (RETURN, >171)
- 170 (REF: DROUGHT, DRYTIMES)
  - >171 (REF: 170, 84)
- 172 (TIME OF, IN: 169, MARCH)

173 (BEGIN, >174, DRY-UP)
- >174 (REF: WATERHOLES, 122)

175 (STOP, >176)
- >176 (REF: RAINS, 115)
- 177 (CAUSALITY, WHEN: 173, 175)

178 (BECOME, >179, 183)
- >179 (REF: THEY, >174)
- 180 (QUALITY OF: MUD, SLIPPERY)
- 181 (QUALITY OF: EARTH, 182)
  - 182 (CONJUNCTION: CAKED, WHITE)
  - 183 (TIME OF, BEFORE: 180, 181)

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184 (REMAIN, >185, >194)
      >185 (REF: 186, >174)
        186 (QUALITY OF: 188, 187)
             187 (QUALIFY:   LITTLE, ONLY)
             188 (LOCATION OF, IN: WATERHOLES, 189)
                   189 (QUALITY OF: GROUND, DEEP)
             190 (COVER, 191, >185)
                   191 (QUALITY OF: GRASS, LONG)
                   192 (CONJUNCTION: 188, 190)
        193 (TIME OF, BY: 184, JUNE)
      >194 (LOCATION OF, IN: 184, 24)

195 (LOCATION OF: >196, MILES-APART)
      >196 (REF: THESE-WATERHOLES, 184)
197 (QUALITY OF: 198, 200)
        198 (LOCATION OF, IN: TRAVEL, >199)
             >199 (REF: DESERT, 24)
        200 (QUALIFY: IMPOSSIBLE, NEARLY)
        201 CONJUNCTION: 195, 197)
202 (DRY-UP, >195)
        203 (QUALIFY: 202, COMPLETELY)
        204 (TIME OF, IN: 202, AUGUST)
        205 (CAUSALITY, WHEN: 201, 202)
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206 (FACE, A:>207, O:209)
     207 (MANNER OF, LIKE: >208)
          >208 (REF: ANIMALS, PLANTS, 17)
     209 (ISA: 212, TASK)
          210 (FIND, >208, WATER)
          211 (STORE, >208, WATER)
               212 (CONJUNCTION: 210, 211)
213 (ADAPT-TO, >207, >214)
    >214 (REF: DESERT-ENVIRONMENT, 24)
     215 (PURPOSE, IN-ORDER-TO: 206, 213)
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216 (SEEK, 217, O: DRINK, G:219)
     217 (NUMBER OF: >218, SOME)
          >218 (REF: DESERT ANIMALS, >209)
     219 (QUALITY OF: PLACE, SURPRISING)
220 (STORE, 217, WATER, 219)
     221 (DISJUNCTION, OR: 216, 220)
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222 (LAP, >223, 227)
    >223 (ISA: 224, 216)
          224 (CONJUNCTION: LIZARDS, INSECTS)
     225 (TIME OF, AT: 222, DAYBREAK)
    >226 (REF: 222, 216)
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227 (REF: DEW, 232)
     228 (FORM, 229)
          229 (ISA: 230, WATER)
               230 (QUALITY OF: DROP, TINY)
     231 (QUALITY OF:NIGHT, COOL)
          232 (CAUSALITY, WHEN: 228, 230)

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233 (CARRY, >234, I;235, O:239)
    >234 (ISA: DESERT-TORTOISE, 220)
     235 (NUMBER OF 236, TWO)
          236 (LOCATION OF, IN: SACS, 237)
               237 (POSSESS, >234, 238)
                    238 (PART OF: SHELL, UPPER)
     239 (SOME OF 240, EXTRA)
          240 (LOCATION OF, IN: WATER, BODY)
          241 (PURPOSE, FOR: 235, 239)

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242 (SERVE, 243, I:244, O:>234)
    >243 (REF: THESE-SACS, 235)
     244 (IN THE MANNER OF: 245)
          245 (NUMBER OF:CANTEENS, TWO)

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246 (TRAVEL, 252, S:>253, G:>254)
     247 (SOME OF: 248, 249)
          248 (NUMBER OF: BIRDS, MANY)
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249 (ISA: OSTRICH, BIRD)

250 (SOME OF: >251, ANTELOPE)

>251 (REF: GRASSEATERS, 160)

252 (CONJUNCTION: 249, 250)

>253 (REF: DESERT, 24)

>254 (REF: WATERHOLES, 195)

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255 (SEEK, >257, 258)

256 (QUALIFY: 255, OFTEN)

>257 (REF: THEY, 252)

258 (LOCATION OF, OUTSIDE: WATER, >259)

>259 (REF: DESERT, 24)

260 (QUALITY OF: >258, 261)

261 (QUALIFY: DRY, VERY)

262 (CAUSALITY, WHEN: 255, 260)

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263 (LIVE, 264, >265)

264 (ISA: BUSHMEN, PEOPLE)

>265 (REF: KALAHARI-DESERT, 24)

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266 (QUALITY OF: 264, 267)

267 (QUALIFY: SMALL, RATHER)

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268 (QUALITY OF: >269, 273)

>269 (REF: ADULTS, 263)

270 (NUMBER OF: FEET-TALL, FOUR-&-ONE-HALF

271 (NUMBER OF: FEET-TALL, 272)

272 (EXTENT OF: FIVE, JUST-OVER)

273 (CONTRAST, BETWEEN: 270, 271)

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274 (LIVE, >276, 277)

275 (QUALIFY: 274, ONCE)

>276 (REF: THESE-PEOPLE, 263)

277 (QUALITY OF: 278, RICH)

278 (LOCATION OF, IN: GRASSLANDS, SOUTH-AFRICA)

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279 (STRUGGLE-FOR, 282, O:277)

>280 (LIVE, 281, 277)

281 (RAISE, PEOPLE, CATTLE)

282 (CONJUNCTION: 274, >280)

283 (DRIVE, A:280, O:274, S:>284, G:>285)

>284 (REF: $, 277)

>285 (REF: NORTH, 24)

286 (PURPOSE, IN-ORDER-TO: 279, 283)

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287 (FIND, >288, 289)

>288 (REF: THEY: 263)

289 (LOCATION OF: SAFETY, >290)

>290(REF: KALAHARI, 24)

291 (LIVE, >292)

>292 (REF: $, 263)

293 (IN MANNER OF: 291, 297)

294 (ISA: 295, PEOPLE)

295 (CONJUNCTION: HUNTERS, GATHERERS)

296 (QUALITY OF: PEOPLE, EARLIEST)

297 (CONTRAST, EQUAL TO: 294, 296)

298 (CONJUNCTION: 287, 291)

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299 (PLANT, >300, CROPS)

>300 (REF: BUSHMAN, 263)

301 (HERD, >300, ANIMALS)

302 (NEGATE: 303)

303 (DISJUNCTION, OR: 299, 301)

304 (QUALITY OF: >305, HARSH)

>305 (REF: DESERT-CONDITIONS, 24)

306 (CAUSALITY, BECAUSE: 304, 302)

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307 (GATHER, >308, 309)

>308 (REF: THEY, >300)

309 (CONJUNCTION: ROOTS, BERRIES, NUTS)

310 (HUNT, >311, ANIMALS)

>311 (REF: $, >308)

312 (CONJUNCTION: 302, 310)

313 (CONCESSION, INSTEAD-OF: 30_, 312)

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314 (MOVE, >316, G:317)

315 (QUALIFY: 314, NECESSARY)

>316 (REF: BUSHMEN, >300)

317 (QUALITY OF: PLACE, NEW)

318 (BECOME, 319, DRY)

319 (LOCATION OF: >320, PRESENT-PLACE)

>320 (REF: WATERHOLES, 201)

321 (REMAIN, 322)

322 (EXTENT OF: FOOD, LITTLE)

323 (CONJUNCTION: 318, 321)

324 (CAUSALITY, WHEN: 323, 314)

325 (QUALIFY: 314, OFTEN)

326 (SEARCH-FOR: 327, 328)

>327 (REF: THEIR, >316)

328 (CONJUNCTION: FOOD, WATER)

329 (PURPOSE: 325, 328)

330 (STAY, >332, G:333)

331 (NEGATE: 330)

>332 (REF: THEY, >327)

333 (NUMBER OF: SPOT, ONE)

334 (MIGRATE, >335, S:336, G:337)

>335 (REF: $, >332)

336 (QUALITY OF: PLACE, PRESENT)

337 (SOME OF: PLACE, ANOTHER)

338 (CONCESSION, BUT: 331, 334)

>339 (REF: 324, 338)

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340 (REF: >341, NOMAD)

>341 (REF: SUCH-PEOPLE, >332)

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342 (SET-UP, 344, 346)

>343 (ISA: BAND, 263)

344 (NUMBER OF: 343, 345)

345 (EXTENT OF: TWENTY, ABOUT)

346 (REF: WERF, CAMP)

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347 (WALK, VISITOR, 349)

348 (QUALIFY:347, PROBABLY)

349 (LOCATION OF, THROUGH: 346, 347)

350 (KNOW, VISITOR, >352)

351 (NEGATE: 350)

>352 (REF: IT, 347)

353 (LOOK-LIKE, 355, BUSHES)

354 (QUALIFY: 353, MUCH)

355 (MAKE, >356, I:357, 358)

>356 (REF: $, >344)

357 (CONJUNCTION: STICKS, GRASS)

358 (QUALITY OF: HOUSES, 359)

359 (CONJUNCTION: SMALL, CONE-SHAPED)

360 (CAUSALITY: 350, 353)

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361 (LIVE-IN, >362, >363)
    >362(REF: BUSHMEN, >343)
    >363 (REF: THESE-SKERMS, 355)
364 (GIVE, >365, 371)
    >365 (REF: THEM, >362)
     366 (TIME OF, DURING: SHADE, DAY)
     367 (TIME OF, WHEN: SHELTER, 368)
            368 (BLOW, 369)
                  369 (QUALITY OF: WINDS, 370)
                        370 (TIME OF, AT: COOL, NIGHT)
            371 (CONJUNCTION: 366, 367)
    >372 (CAUSALITY: 361, 364)
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373 (PLACE, >375, 376)
     374 (QUALIFY:373, CAREFULLY)
    >375 (REF: $, >362)
     376 (ISA: ROW, 377)
            377 (QUALITY OF: EGGSHELL, OSTRICH)
            378 (LOCATION OF, NEAR: 376, HOUSES)
379 (DECORATE, >375, 377, G:381)
     380 (QUALIFY: 379, OFTEN)
     381 (CARVE, >375, 384)
            382 (QUALITY OF: DESIGN, 383)
                  383 (CONJUNCTION: ZIGZAGS, DIAMONDS)
                  384 (DISJUNCTION, OR: 382, ANIMAL-PICTURES)
            385 (TIME OF, BEFORE: 373, 379)
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386 (QUALITY OF: 377, IMPORTANT)

387 (HOLD, >388, WATER)

    >388 (REF: THEY, 377)

     389 (CAUSALITY, BECAUSE: 386, 387)
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390 (FILL, >391, I:392, O:>394)

    >391 (REF: $, >362)

     392 (CUT, >391, 393)

         393 (LOCATION OF, IN: HOLE, SHELL)

    >394 (REF: EACH-ONE, 377)

    >395 (PURPOSE OF: 390, 389)
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396 (STOP-UP, $, I:GRASS, >397)

    >397 (REF: HOLE, 393)

     398 (TIME OF, AFTER: 390, 396)
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399 (POSSESS, $, 401)

    400 (LOCATION OF, IN: 399, 24)

    401 (QUALITY OF: TASK, MAIN)

402 (FIND, $, 403)

    403 (CONJUNCTION: FOOD, WATER)

404 (SURVIVE, $)

    405 (PURPOSE OF: 402, 404)

    406 (REF: 399, 405)
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407 (KNOW, >409, >410)
     408 (QUALIFY: 407, WELL)
    >409 (REF: BUSHMEN, >362)
    >410 (REF: LAND, 24)

411 (SEARCH-FOR, >409, 413)
     412 (QUALIFY: 411, NECESSARY)
     413 (QUALITY OF: WATER-SOURCE, NEW)
414 (DRY-UP, $, >415)
    >415 (REF: WATERHOLES, >320)
     416 (CAUSALITY, WHEN: 411, 414)

417 (FIND, >409, WATER, S:418)
     418 (LOOK-FOR, NO-ONE-ELSE, >419)
         >419 (REF: $, WATER)

420 (WALK-TO, >422, 423)
     421 (QUALIFY: 420, POSSIBLY)
    >422 (REF: HE, >409)
     423 (QUALITY OF: 424, LITTLE)
          424 (LOCATION OF: BUSH, CLOSE-BY)
425 (PULL-OUT, >426, TSAMA-MELON)
    >426 (REF: $, >422)
     427 (TIME OF, AFTER: 420, 425)
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428 (MAKE, >422, 429)
     429 (LOCATION OF, IN: HOLE, >430)
          >430 (LOCATION OF, IN: TOP, TSAMA-MELON)
     431 (TIME OF, AFTER: 425, 428)
432 (MASH, >422, I:STICK, >433)
    >433 (LOCATION OF, IN: INSIDES, TSAMA-MELON)
     434 (CONJUNCTION: 428, 432)
435 (DRINK, >422, 436)
     436 (QUALITY OF: >437, GOOD)
          >437 (LOCATION OF, IN: JUICE, TSAMA-MELON)
     438 (TIME OF, AFTER: 434, 435)
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439 (EAT, $, 440)
     440 (ISA: PLANT, 441)
          441 (CONJUNCTION: BI-ROOT, GA-ROOT, WILD-CUCUMBER)
442 (GET, >444, JUICE)
     443 (QUALIFY:442, POSSIBLY)
    >444 (REF: $, >422)
     445 (PURPOSE: 439, 442)
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446 (GET, >447, WATER, S:SIPWELLS)
    >447 (REF: BUSHMAN, >444)
    >448 (REF: 417, 449)
          449 (CONJUNCTION: 438, 445, 446)
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450 (HOLD, 451, RAINWATER)
      451 (QUALITY OF: SAND, MOIST)
      452 (LOCATION OF: 450, SOME-PLACES)
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453 (LOCATION OF: >454, 455)
     >454 (REF: WATER, 450)
      455 (EXTENT OF: BELOW-SURFACE, 456)
            456 (NUMBER OF: FEET, THREE-TO-FOUR)
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457 (DIG, >458, I:462, SAND)
     >458 (REF: HE, >447)
      459 (ISA: 460, GRASS)
            460 (PART OF: REED, HOLLOW-STEM)
            461 (PART OF: DRINKING-STRAW, HOLLOW-STEM)
                  462 (MANNER OF, LIKE: 459, 461)
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463 (SUCK, >464, I:>465, >466)
     >464 (REF: HE, >458)
     >465 (REF: REED, 462)
     >466 (REF: WATER, 453)
           >467 (REF: 446, 468)
                >>468 (CONTRAST, EQUAL TO: SUCK, SIP)
                       >469 (REF: 450, 446)
470 (STORE, >471, >466, G:>472)
     >471 (REF: $, 464)
     >472 (REF: OSTRICH-EGGSHELL, 387)
      473 (TIME OF, AFTER: 463, 470)
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474 (WORK, >476, O:>477, G:SURVIVAL)
       475 (QUALIFY:474, HARD)
      >476 (REF: BUSHMEN, >464)
      >477 (REF: THIS-NECESSITY, WATER)

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478 (GATHER, 479, 480)
       479 (CONJUNCTION: WOMEN, CHILDREN)
       480 (CONJUNCTION: FRUIT, NUTS)

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481 (MAKES-UP, MEAT, G:482)
       482 (EXTENT OF: SMALL-PART, 483)
              483 (EAT, >484, FOOD)
                  >484 (REF: BUSHMEN, >476)

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485 (DEPEND-ON, >488, >489)
       486 (QUALIFY:485, ALWAYS)
       487 (NEGATE: 485)
      >488 (REF: BUSHMEN, >484)
      >489 (REF: ANIMALS, 481)
      >490 (CAUSALITY: 481, 485)
491 (DEPEND-ON, >488, PLANTS)
       492 (QUALIFY:491, ALWAYS)
       493 (CONCESSION: 485, 491)

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494 (GATHER, >495, 496, G:FOOD)

     >495 (REF: $, >488)

      496 (NUMBER OF: PLANT-KINDS, OVER-ONE-HUNDRED)

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497 (REF: 494, 498)

      498 (CONJUNCTION: ROOTS, BULBS, >499, 500, NUTS, LEAFY-GREENS)

          >499 (REF: BERRIES, FRUIT)

           500 (NUMBER OF: FRUITS, MORE)

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501 (ISA: MONGONGO-NUT, 504)

      502 (QUALITY OF: 501, 503)

           503 (QUALIFY: IMPORTANT, MOST)

      504 (NUMBER OF: 497, ONE)

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505 (ISA: 501, 506)

      506 (POSSESS, >507, 508)

          >507 (REF: BUSHMEN, >495)

           508 (PART OF: DIET, MAJOR)

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509 (GO,510, G:512)

      510 (NUMBER OF:>511, SOME)

          >511 (REF: WOMEN-&-CHILDREN, 479)

      512 (GATHER, >513, >514)

          >513 (REF: $, 510)

          >514 (REF: PLANTS, 497)
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515 (TIME OF: 509, 516)
516 (PART OF: 517, EARLY)
517 (NUMBER OF: MORNING, EACH)

518 (LOCATION OF: SUN, UP)
519 (NEGATE: 518)
>520 (REF: 509, 519)
521 (QUALIFY: >522, 523)
>522 (REF: KALAHARI, 24)
523 (QUALIFY: HOT, ALREADY)
524 (CONCESSION, BUT: 518, 521)

525 (WALK, >526, G:527)
>526 (REF: THEY, 513)
527 (NUMBER OF: MILES, MANY)
528 (FIND, >526, ANYTHING)
529 (TIME OF, BEFORE: 525, 528)
530 (TIME OF: 529, 531)
531 (NUMBER OF: MORNINGS, SOME)

532(USE, WOMEN, 533)
533 (REF: DIGGING-STICK, 535)
534 (QUALITY OF: BRANCH, 536)
535 (QUALIFY: 534, USUALLY)
536 (CONJUNCTION: TALL, POINTED)

537 (BREAK, >538, I:>539, 540)
>538 (REF: THEY, WOMEN)

>539 (REF: THIS, 533)

540 (QUALITY OF: EARTH, SUNBAKED)

541 (FREE, >538, I:>539, 542)

542 (DISJUNCTION, OR: ROOTS, PLANTS)

543 (CONJUNCTION: 537, 541)

544 (GATHER: >538, 542)

545 (TIME OF, AFTER: 543, 544)

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546 (MASH, >541, I:547, 550)

547 (REF: STAMPING-BLOCK, 548)

548 (QUALITY OF: BOWL, 549)

549 (CONJUNCTION: SHALLOW, WOODEN)

550 (CONJUNCTION: SEEDS, NUTS)

551 (LOCATION OF, BACK-AT: 546, >552)

>552 (REF: WERF, 346)

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553 (QUALIFY: HUNTERS, BUSY)

554 (TIME OF: 553, 555)

555 (PART OF: MORNING, EARLY)

>556 (QUALIFY: WOMEN, BUSY)

>557 (CONJUNCTION, ALSO: 553, 556)

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558 (PREPARE, >560, ARROWS)

559 (QUALIFY: 558, NECESSARY)

>560 (REF: THEY, 553)

561 (GO, >560, $)

562 (TIME OF, BEFORE: 558, 561)

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563 (FILE, >564, IRON-PIECES)
    >564 (REF: HUNTERS, 553)
565 (MAKE, >564, POINTS, G: ARROWHEADS)
     566 (PURPOSE, IN-ORDER-TO: 563, 565)
     567 (TIME OF, BEFORE: 566, 568)

568 (TIE, >570, O:ARROWHEADS, G:SPLIT-STICKS)
     569 (QUALIFY: 568, CAREFULLY)
    >570 (REF: $, 553)
571 (SMEAR-WITH, >570, I:572, O:>573)
     572 (KILL, POISON, ANIMALS)
    >573 (REF: $, ARROWHEADS)
     574 (TIME OF, BEFORE: 568, 571)

575 (MAKE, $, >576, S:586)
    >576 (REF: THIS-POISON, 572)
     577 (DISJUNCTION, OR: BARK, ROOTS)
     578 (POSSESS: >579, 580)
         >579 (ISA: NGOA-MOTH, INSECT)
          580 (QUALITY OF: INSECT-LARVAE, DRIED)
          581 (CONJUNCTION: 577, 578)

582 (USE, $, VENOM, S:584)
     583 (QUALIFY: 582, SOMETIMES)
     584 (ISA: MAMBA, 585)
          585 (QUALITY OF: SNAKE, DEADLY)
         >586 (DISJUNCTION, OR: 581, 582)
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587 (STICK, >589, ARROWS, G:SAND)
     588 (QUALIFY: 587, POINTS-UP)
    >589 (REF: $, >564)
590 (DRY, $, POISON)
     591 (TIME OF, UNTIL: 587, 590)
    >592 (TIME OF, BEFORE: 574, 591)
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593 (READY, >594, HUNT)
    >594 (REF: MEN, >564)
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595 (HUNT, >597, I:598, O:603)
     596 (QUALIFY: 595, REGULARLY)
    >597 (REF: $, >594)
     598 (QUALITY OF: ARROW, POISONED)
    >599 (ISA: ANTELOPE, 600)
          600 (QUALITY OF: ANIMAL, LARGE)
     601 (QUALITY OF: 602, LARGE)
          602 (SOME OF: ANIMALS, OTHER)
          603 (CONJUNCTION: >599, 601)
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604 (HUNT, >606, 607)
     605 (QUALIFY: 604, IN-OTHER-WAYS)
    >606 (REF: BUSHMEN, >594)
     607 (QUALITY OF: ANIMALS, SMALLER)
    >608 (CONTRAST: 595, 604)
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609 (DIG-INTO, >611, $, 612)

     610 (QUALIFY: 609, SOMETIMES)

    >611 (REF: THEY, >606)

     612 (POSSESS: 613, 615)

          613 (CONTRAST, SIMILAR-TO: ANIMALS, >614)

              >614 (ISA: SPRINGHARES, 604)

          615 (LOCATION OF: BURROW, UNDERGROUND)

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616 (HOOK, >617, I:618, O:>621)

    >617 (REF: HUNTERS, >611)

     618 (ATTACH-TO, $, I:619, O:620)

          619 (QUALITY OF: HOOK, METAL)

          620 (QUALITY OF: POLE, LONG)

    >621 (REF: ANIMAL, >614)

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622 (DIG-UP, >623, 624)

    >623 (REF: THEY, >617)

     624 (QUALITY OF: SAND, SOFT)

625 (CAPTURE, >623, >626)

    >626 (REF: IT, >621)

     627 (PURPOSE: 622, 625)

     628 (TIME OF, AFTER: 622, 625)

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629 (ISA: 630, 634)

     630 (HUNT, $, 631, G:FOOD)

          631 (SOME OF: ANIMAL, ANOTHER)
          >632 (HUNT, $, 633, G:FOOD)
                 633 (CONJUNCTION: 595, 604)
      634 (QUALITY OF: LEOPARD-TORTOISE, BIG)

635 (WEIGH, >636, 637)
     >636 (REF: THIS-TORTOISE, 634)
      637 (NUMBER OF: POUNDS, 638)
            638 (EXTENT OF: EIGHT, UP-TO)

639 (CATCH, 641, >642)
      640 (QUALIFY: 639, EASILY)
      641 (DISJUNCTION, OR: MEN, WOMEN, CHILDREN)
     >642 (REF: IT, >636)

643 (BAKE, $, >645)
      644 (QUALIFY: 643, IN-THE-SHELL)
     >645 (REF: TORTOISE, >642)
646 (EAT, 647, >648)
      647 (NUMBER IN: FAMILY, FOUR)
     >648 (REF: $, >645)
      649 (PURPOSE: 643, 646)

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650 (WANDER, >653, S:654, G:654)
      651 (QUALIFY: 650, ALONE)
      652 (NEGATE: 650)
     >653 (REF: BUSHMEN, >641)
      654 (EXTENT OF: DESERT, WHOLE)
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655 (LIVE-IN, >656, >658)

>656 (REF: THEY, >653)

657 (QUALITY OF: >658, SMALL)

>658 (REF: BANDS, 343)

659 (SURVIVE, >660)

>660 (REF: $, >656)

661 (PURPOSE, IN-ORDER-TO: 655, 659)

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662 (POSSESS: >663, 670)

>663 (REF: 657, 664)

664 (NUMBER OF: BAND, EACH)

665 (PART OF: TERRITORY, >666)

>666 (REF: WATERHOLE, 121)

667 (PART OF: TERRITORY, 668)

668 (EXTENT OF: LAND, 669)

669 (QUALITY OF: STRETCH, VAST)

670 (CONJUNCTION: 665, 667)

---

671 (ASK, >673, PERMISSION)

672 (QUALIFY: 671, NECESSARY)

>673 (REF: EACH-BAND, >663)

674 (CROSS, >675, 676)

>675 (REF: $, >673)

676 (POSSESS, 677, >678)

677 (SOME OF: BANDS, ANOTHER)

>678 (REF: TERRITORY, 670)

679 (PURPOSE: 671, 674)

```
680 (MOVE-TO, >681, 682)
    >681 (REF: IT, >673)
     682 (SOME OF: 683, ANOTHER)
          683 (LOCATION OF, IN: PLACE, OWN-TERRITORY)
    >684 (CAUSALITY: 674, 680)
```

```
685 (CREATE, 687, 689)
    686 (QUALIFY: 685, PARTIALLY)
    687 (ARRANGE, $, LAND, G:>688)
        >688 (REF: TERRITORIES, >678)
    689 (LOCATION OF,IN: ORDER, 690)
        690 (QUALITY OF: CULTURE, 691)
            691 (CONJUNCTION: HUNTING, GATHERING)
```

```
692 (KNOW, >694, >695)
     693 (QUALIFY: 692, WELL)
    >694 (REF: PEOPLE-OF-THE-BAND, >682)
    >695 (REF: 696, 670)
          696 (QUALIFY: TERRITORY, THEIR)
    >697 (REF: 407, 692)
```

```
698 (KNOW, >699, O:700)
    >699 (REF: HUNTERS, >617)
     700 (FIND, >701, >702)
         >701 (REF: $, >699)
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        >702 (REF: GAME, ANIMALS)
         703 (TIME OF: 700, 704)
              704 (NUMBER OF: 705, CERTAIN)
                   705 (CONJUNCTION: SEASONS, TIMES-OF-DAY)


706 (KNOW, >707, 708)
  * >707 (REF: THEY, >699) --[True reference; THEY, >694]
     708 (LOOK-FOR, >707, >709)
         >709 (REF: SIPWELLS, >469)
     710 (TIME OF, IN, 706, DRY-TIMES)


711 (KNOW, >712, 713)
    >712 (REF: BUSHMEN, >694)
     713 (LOOK-FOR, >712, FOOD)
          714 (QUALIFY: 713, LATER)
     715 (REMEMBER, >712, 716)
          716 (GROW, >717)
              >717 (REF: 718, >514)
               718 (QUALITY OF: PLANT, GREEN)
               719 (TIME OF: 716, >720)
                   >720 (REF: RAINY-SEASON, 115)
          721 (CAUSALITY: 710, 713)


722 (FIND, >723, 724)
    >723 (REF: THEY, >712)
     724 (QUALITY OF:LEAVES, DRIED-UP)
```

```
725 (DIG-FOR, >726, O:ROOTS, GROUND)
     >726 (REF: $, >723)
       727 (CONJUNCTION: 722, 725)

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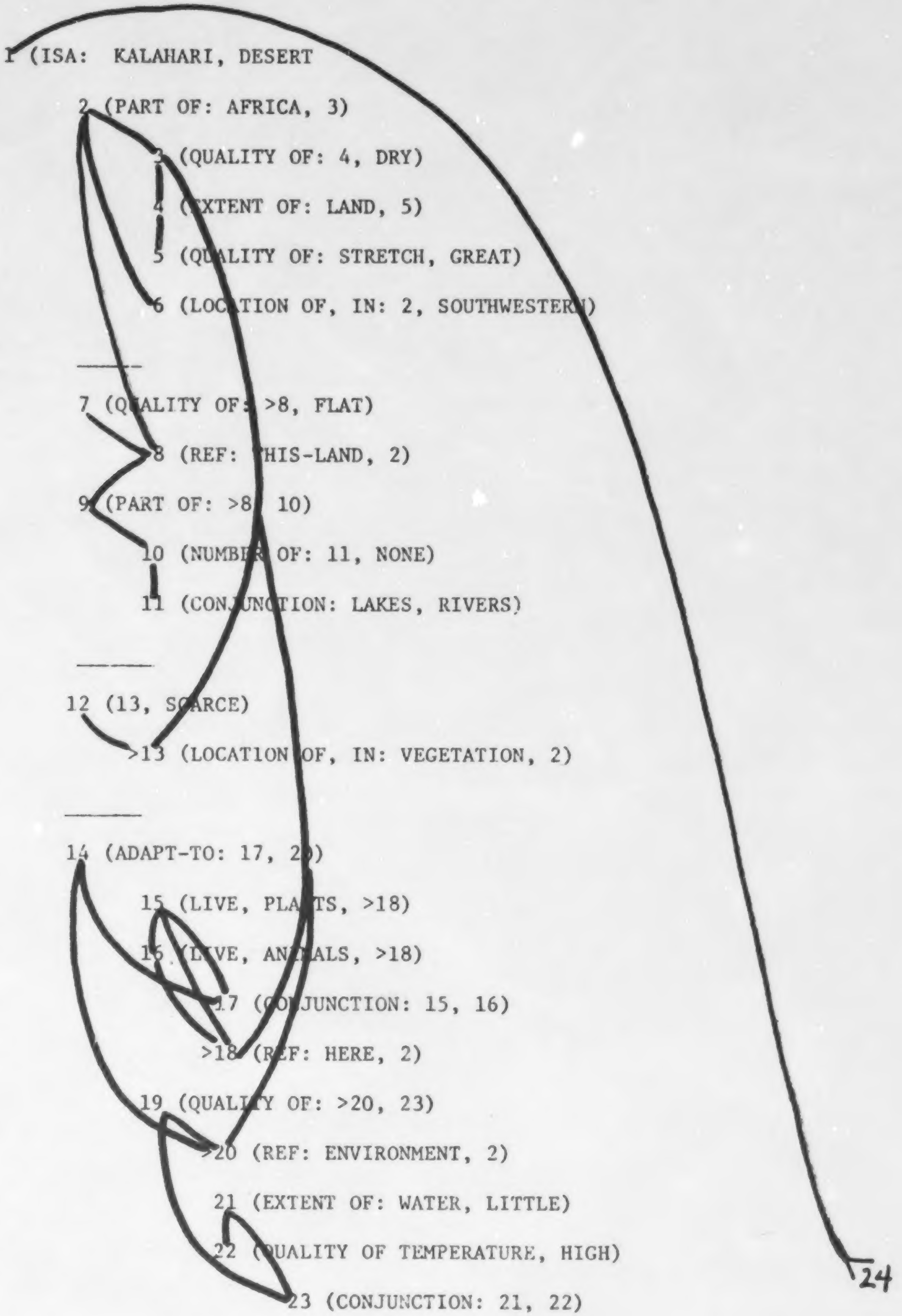


1 (ISA: KALAHARI, DESERT
2 (PART OF: AFRICA, 3)
3 (QUALITY OF: 4, DRY)
4 (EXTENT OF: LAND, 5)
5 (QUALITY OF: STRETCH, GREAT)
6 (LOCATION OF, IN: 2, SOUTHWESTERN)

7 (QUALITY OF: >8, FLAT)
>8 (REF: THIS-LAND, 2)
9 (PART OF: >8, 10)
10 (NUMBER OF: 11, NONE)
11 (CONJUNCTION: LAKES, RIVERS)

12 (13, SCARCE)
>13 (LOCATION OF, IN: VEGETATION, 2)

14 (ADAPT-TO: 17, 20)
15 (LIVE, PLANTS, >18)
16 (LIVE, ANIMALS, >18)
17 (CONJUNCTION: 15, 16)
>18 (REF: HERE, 2)
19 (QUALITY OF: >20, 23)
>20 (REF: ENVIRONMENT, 2)
21 (EXTENT OF: WATER, LITTLE)
22 (QUALITY OF TEMPERATURE, HIGH)
23 (CONJUNCTION: 21, 22)

1

2

24 (ISA: 25, 1)

>25 (REF: THIS-LAND, 2)

26 (COVER, 1, 30)

27 (PART OF: AFRICA, SOUTHERN)

28 (NUMBER OF: 29, THREE)

15

>29 (SOME OF: NATIONS, PART-OF)

20

30 (LOCATION OF, IN: 28, 27)

31 (ADAPT-TO, 15, >31a)

>31a (REF: DESERT ENVIRONMENT, 20)

32 (IDA: 33, 35)

33 (NUMBER OF: >34, MOST)

>34 (REF: THESE-PLANTS, 15)

35 (CONJUNCTION: GRASSES, BUSHES)

36 (SEE, $, 38)

24

37 (QUALIFY: 36, EVERY-NOW-AND-THEN)

38 (QUALITY OF: 39, HUGE)

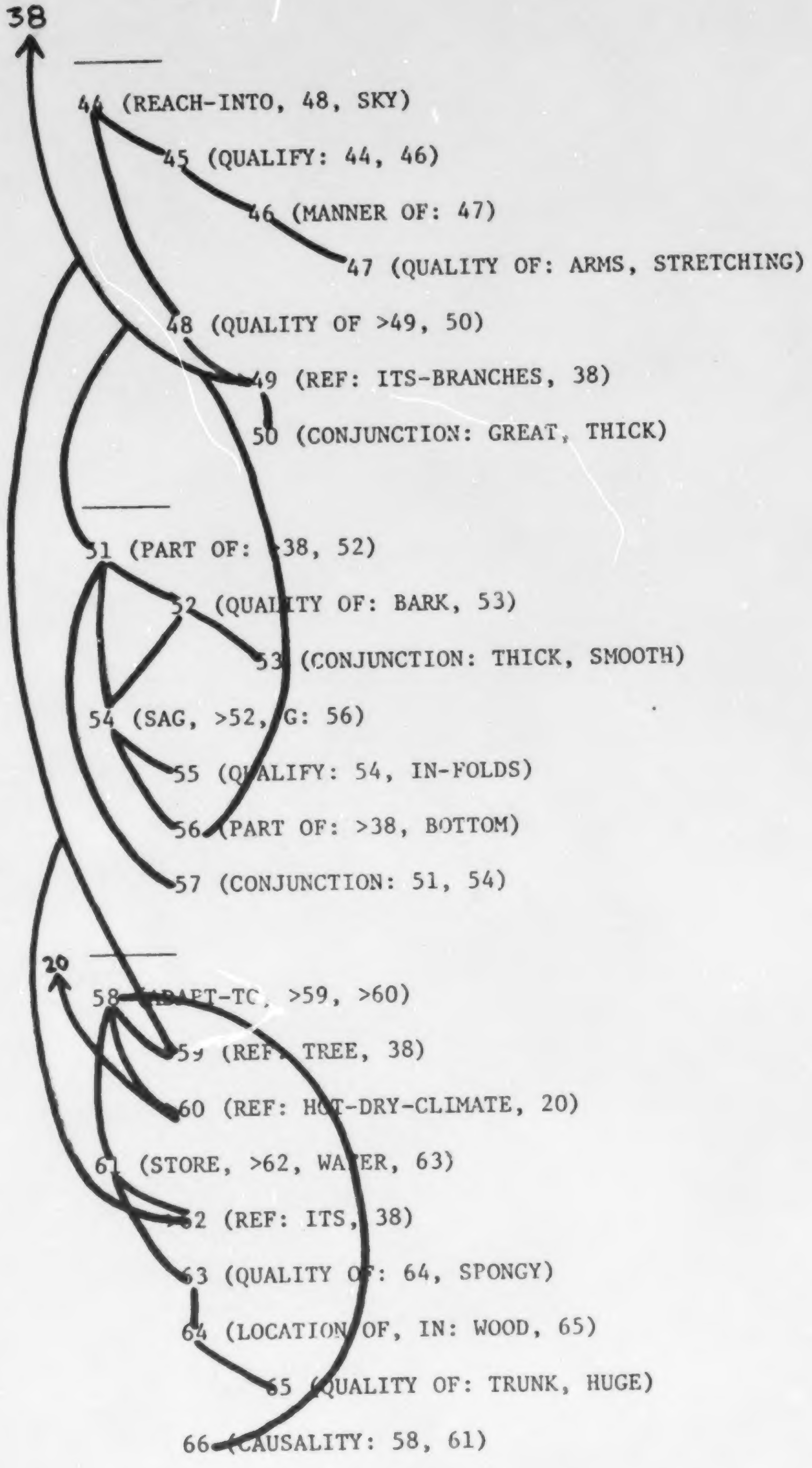
39 (EXTENT OF: 40, TWO-HUNDRED-FOOT)

40 (LOCATION OF, IN: BAOBAB-TREE, 41)

41 (QUALITY OF: >42, BARREN)

>42 (REF: DESERT, 24)

43 (CONCESSION, HOWEVER: 32, 36)



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44 (REACH-INTO, 48, SKY)
45 (QUALIFY: 44, 46)
46 (MANNER OF: 47)
47 (QUALITY OF: ARMS, STRETCHING)
48 (QUALITY OF >49, 50)
49 (REF: ITS-BRANCHES, 38)
50 (CONJUNCTION: GREAT, THICK)

---

51 (PART OF: >38, 52)
52 (QUALITY OF: BARK, 53)
53 (CONJUNCTION: THICK, SMOOTH)
54 (SAG, >52, DEG: 56)
55 (QUALIFY: 54, IN-FOLDS)
56 (PART OF: >38, BOTTOM)
57 (CONJUNCTION: 51, 54)

---

58 (ADAPT-TO, >59, >60)
59 (REF: TREE, 38)
60 (REF: HOT-DRY-CLIMATE, 20)
61 (STORE, >62, WATER, 63)
62 (REF: ITS, 38)
63 (QUALITY OF: 64, SPONGY)
64 (LOCATION OF, IN: WOOD, 65)
65 (QUALITY OF: TRUNK, HUGE)
66 (CAUSALITY: 58, 61)

APPENDIX C

ACTIVITIES

(Version received by the NA and NS groups. Appropriate answers have been written in.)

ACTIVITY SHEET A

1. The word that means the Kalahari Desert has very little vegetation is scarce.

2. The words that mean the Kalahari Desert does not have very many trees are every now and then.
   or
   across the barren desert

3. The cool months in the desert are June and July.

4. The desert has rain in the months of December, January, and February.

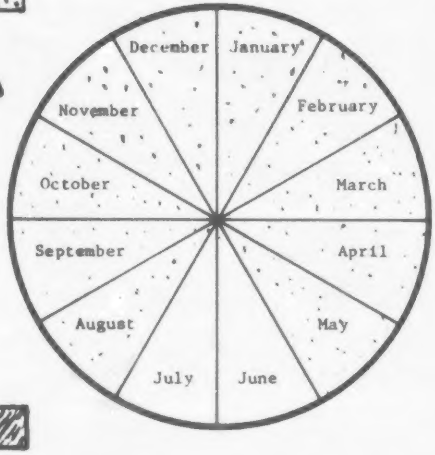
5. Therefore, seeds sprout in the months of December, January, and February.

6. From my answers to 3 and 4, I know that (CIRCLE ONE):

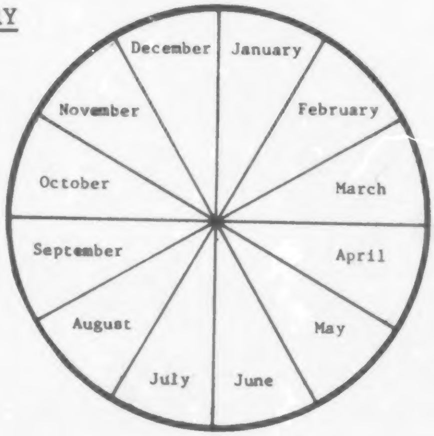
   a. The Kalahari has rain in the cool months.

   [✓ b.] The Kalahari has no rain in the cool months.

7. From my answer to 3, I can put dots ░ on all the months that are HOT:


December
January
February
March
April
May
June
July
August
September
October
November

8. From my answer to 4, I can shade in ▨ all the months that are DRY and have NO RAIN:


December
January
February
March
April
May
June
July
August
September
October
November

9. From the two diagrams, I know that when it rains the Kalahari is:

(CIRCLE ONE) a. cool [✓ b.] hot

10. "When times are very dry, they often seek water outside the desert."

Circle the names of the animals that do this:

a. lizards [✓ b.] antelope c. insects d. tortoises [✓ e.] ostrich

11. The "surprising places" some animals seek or store water are:

Lizards and insects dew.

Desert tortoises two sacs under shell.

Ostrich and antelope outside the desert.

12. Cross out the two incorrect answers. Circle the correct answer.

Bushmen: ~~a. have always~~ had a home in the Kalahari

b. once were cattle-raising people

[✓ c.] were forced to leave rich grasslands

13. Bushmen must move to a new place when water holes dry up.

14. From my answer to 8, I know that Bushmen move the most often during the months FROM March TO November.

15. Twenty men, women, and children who live together are called a band of Bushmen.

16. A Bushman camp is called a werf.

17. Bushman houses are called skerms.

18. Put the letter of the correct answer in the blank:

1st a Bushman e	a. places an ostrich eggshell near his house
2nd a Bushman d or f	b. fills an ostrich eggshell with water
3rd a Bushman d or f	c. stops an ostrich eggshell up with grass
4th a Bushman b	d. decorates an ostrich eggshell with designs
5th a Bushman c	e. finds an ostrich eggshell
6th a Bushman a	f. cuts a hole in the top of an ostrich eggshell

19. Bushmen eat tsama melons, bi and ga roots, and wild cucumbers to get (CIRCLE ONE):

[✓ a. water]

b. seeds

c. food

use,
need
20. To get water from a sip well, Bushmen suck on a hollow reed.
sip from

21. The reed must be 3-4 feet long.

22. Bushmen eat mostly (CIRCLE ONE):

[✓ a.] plants

b. animals

23. Over 100 kinds of plants are gathered (CIRCLE ONE):

a. only close to the Bushman camp

b. usually inside the Bushman camp

[✓ c.] sometimes miles from the Bushman camp

24. From my answer to 23, I know gathering plants is (CIRCLE ONE):

[✓ a.] hard for Bushmen

b. easy for Bushmen

25. Poison is made from bark or roots and ngoa moth / dried larvae, or venom / mamba.

26. Poisoned arrows are NOT used when Bushmen hunt (CIRCLE TWO):

[✓ a.] small animals

b. large animals

c. leopard tortoises

[✓ d.] springhares

e. antelopes

27. From my answer to 22, I know that the most important activity of Bushmen is (CIRCLE ONE):

a. hunting animals

[✓ b.] gathering plants

28. From my answer to 15, I know that a band is a small group of Bushmen/ men, women, children

29. Each band's territory has at least one water hole.

30. The word territory means where a Bushman lives (CIRCLE ONE):

a. for a short time

[✓ b.] all his life

c. sometimes

31. From the information I read to get the answer to 20, I know that when Bushmen come to a sip well they see (CIRCLE ONE):

a. water

b. dried-up leaves

[✓ c.] sand

32. Bushmen must know their territory well so that they can find things that will give them food and water.

33. From my answers to 7, 8, 9, and 14, I know that life is most difficult for Bushmen when the Kalahari is (CIRCLE ONE):

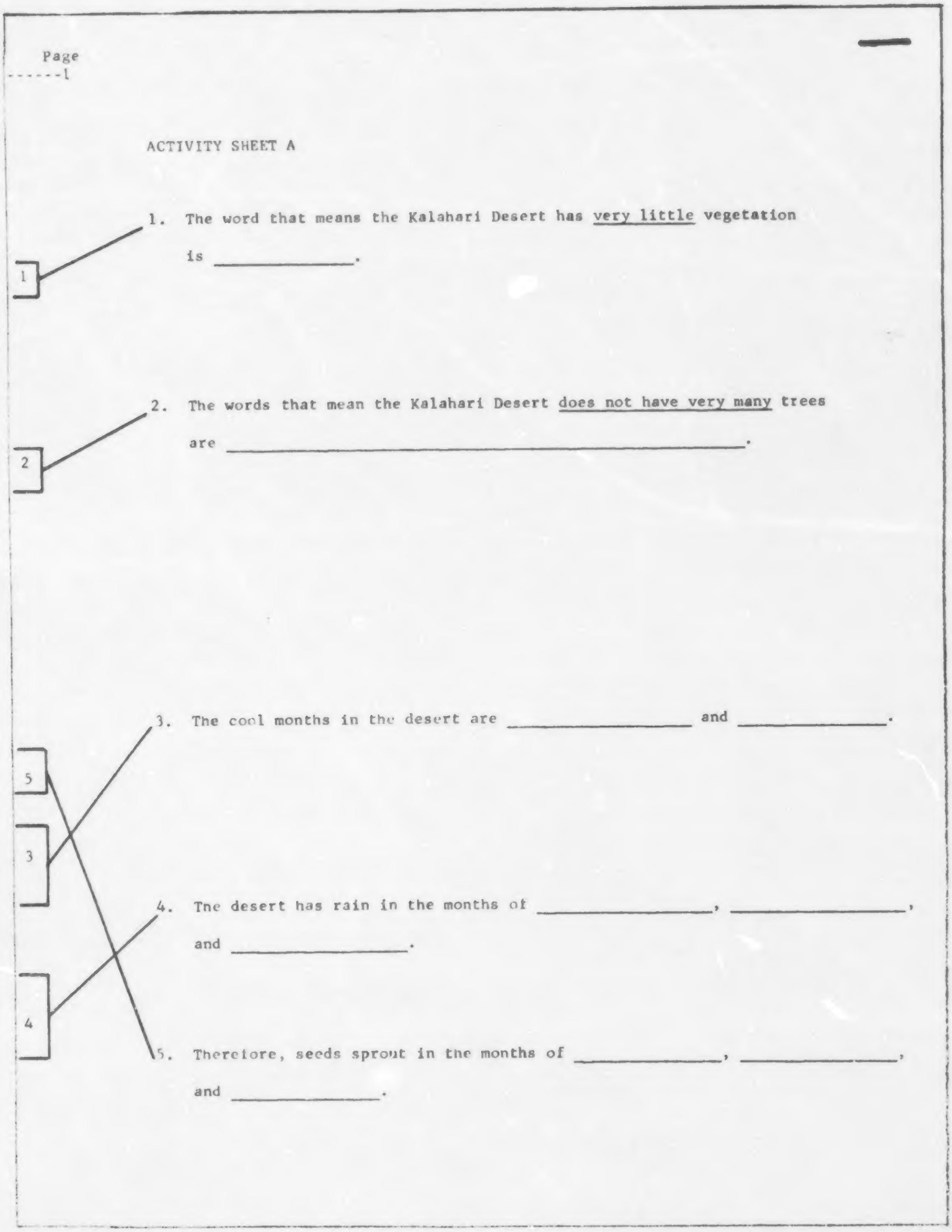
[✓ a.] cool and dry

b. cool and rainy

c. hot and dry

d. hot and rainy

(Sample sheets of the version received by the GA and GS groups, reduced to show the graphic aid.)



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ACTIVITY SHEET A

1. The word that means the Kalahari Desert has very little vegetation is ______________.

2. The words that mean the Kalahari Desert does not have very many trees are ____.

3. The cool months in the desert are ______________ and ______________.

4. The desert has rain in the months of ______________, ______________, and ______________.

5. Therefore, seeds sprout in the months of ______________, ______________, and ______________.

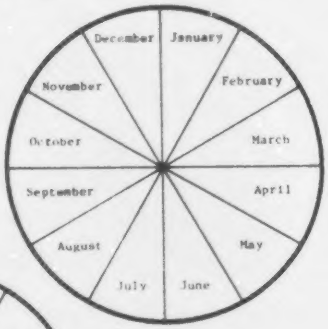
Page
------2

6 From my answers to 3 and 4, I know that: (CIRCLE ONE)

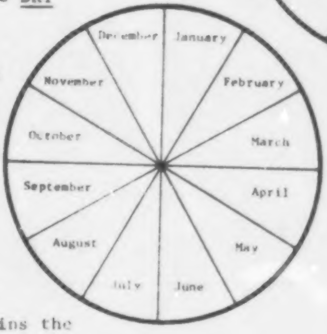
a. The Kalahari has rain in the cool months.

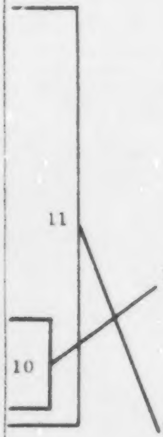
b. The Kalahari has no rain in the cool months.

7. From my answer to 3, I can put dots ▨ on all the months that are HOT:


December
January
February
March
April
May
June
July
August
September
October
November

8. From my answer to 4, I can shade in ☐ all the months that are DRY and have NO RAIN:


December
January
February
March
April
May
June
July
August
September
October
November



9. From the two diagrams, I know that when it rains the Kalahari is: (CIRCLE ONE) a. cool b. hot

10. "When times are very dry they often seek water outside the desert." Circle the names of the animals that do this:

a. lizards b. antelope c. insects d. tortoises e. ostrich

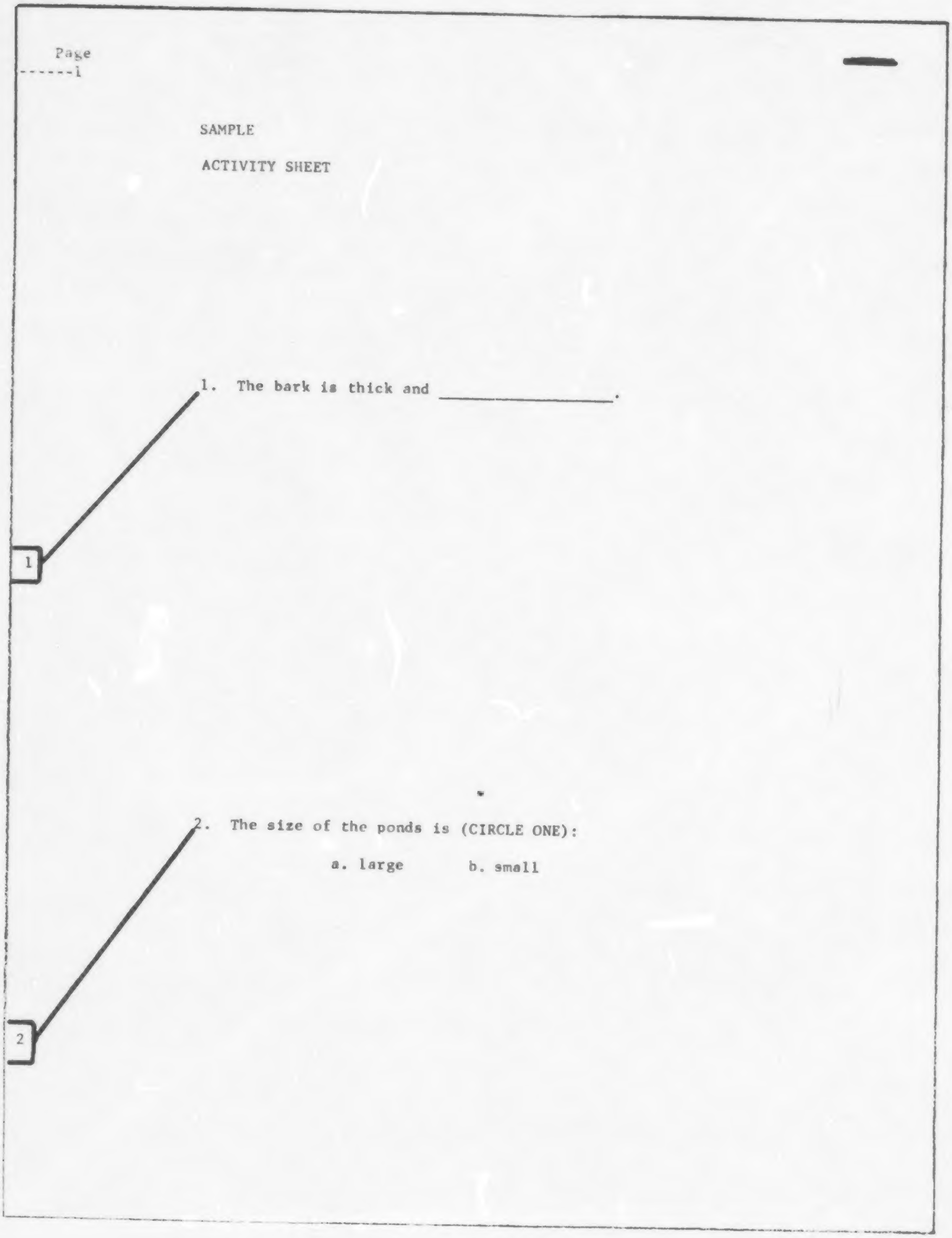
11. The "surprising places" some animals seek or store water are:

Lizards and insects ______________________.

Desert tortoises ______________________.

Ostrich and antelope ______________________.

(Instruction sheet for the GA and GS groups)



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SAMPLE

ACTIVITY SHEET

1. The bark is thick and ________________.

2. The size of the ponds is (CIRCLE ONE):

a. large   b. small

APPENDIX D

COMPREHENSION TESTS

Appendix D

Comprehension Tests

Explanation:

- Correct answers are circled.
- Items marked D were deleted in the revised versions.
- Items marked S in the multiple-choice test are the activity-specific items.
- Items marked I in the multiple-choice test are the activity-irrelevant items.

Multiple-choice Test (Mark your answers on the Answer Sheet)

1. In dry times, Bushmen

[✓ A.] know where to look for water
B. get along without water
C. eat dried-up leaves of plants
D. use only water they have stored

2. In the coolest months, June and July,

A. the rains begin
[✓ B.] the water holes dry up
C. plants bud and blossom
D. water holes are full

3. Bushmen get most of their food from

D

A. hunting animals
B. growing crops
C. water holes
[✓ D.] gathering plants

4. The Kalahari is

A. part of the Sahara
B. mountainous and dry
[✓ C.] in southern Africa
D. the largest desert in the world

5. Water in the Kalahari Desert

A. cannot be found
[✓ B.] sometimes freezes
C. is always warm
D. is found only in sip wells

6. The plants of the Kalahari all grow only

A. where there is some shade
B. near the werfs of the Bushmen
C. if they have deep roots
[✓ D.] during one time of the year

7. Water holes in the Kalahari

[✓ A.] are several miles apart
B. have palm trees around them
C. are found only outside the desert
D. disappear in January and February

8. Poison for arrows is

I

A. made from tortoises
B. filed into points
C. made by women
[✓ D.] dried on the arrows

9. Dried-up leaves of a plant

A. are eaten by Bushmen
B. make poison for arrows
[✓ C.] may indicate roots to eat
D. are used for medicine

10. An animal that sometimes goes outside the desert for water is the

A. lizard
B. springhare
[✓ C.] ostrich
D. tortoise

11. Seeds sprout when the desert is

D

A. cool and dry
B. cool and rainy
C. hot and dry
[✓ D.] hot and rainy

12. Bushmen

S

A. have always lived in the desert
B. once were cattle-raising people
C. leave the desert in dry times
[✓ D.] once lived on rich grasslands

13. Bi and ga roots, tsama melons, and wild cucumbers
S are used as a source of

[✓ A.] water
B. food
C. poison
D. seeds

14. Bushmen eat mostly
D

A. antelope meat
B. leopard tortoises
[✓ C.] roots, fruits, and nuts
D. ostrich eggs

15. When dry times come, many animals
D

A. hibernate in underground skerms
[✓ B.] travel across the desert for water
C. locate lake beds and find water
D. move closer to the Bushmen camps

16. Rains come to the Kalahari during
S

[✓ A.] December, January, and February
B. September, October, and November
C. March, April, and May
D. June, July, and August

17. Extra body water is carried in two body sacs by the
S

A. antelope
B. lion
C. ostrich
[✓ D.] tortoise

18. Sip wells are

A. a few inches from the surface of the land
B. dug so that rainwater can collect
[✓ C.] sucked from with a straw in dry times
D. found in the center of a Bushman camp

19. Arrows are prepared

A. before a feast
B. in the evening
[✓ C.] early in the morning
D. by the women

20. A Bushman camp has

D

A. many animals inside it
B. a thorn fence around it
[✓ C.] a number of small houses
D. one large sleeping shelter

21. Ostrich eggs are used for

[✓ A.] storing water
B. baiting traps
C. making arrowheads
D. feeding families

22. Bushmen hunt with

A. shallow, wooden stamping blocks
[✓ B.] arrows, spears, hooks, and poles
C. only poisoned spears and arrows
D. ropes, spears, and leather nets

23. The women and children

A. work in the camp all day
[✓ B.] gather plants and catch tortoises
C. do not catch animals or hunt
D. only cook and fix the food

24. Bushmen move most often

A. in the hottest season of the year
B. when their band becomes very small
C. in the rainy season of the year
[✓ D.] in the cool season when no rain falls

25. Bushmen live in bands that

A. wander anywhere in the Kalahari Desert
[✓ B.] wander only within a certain territory
C. move outside the desert in dry times
D. fight with each other over territory

26. Bushmen are
I

A. tall, thin nomads
B. brave lion hunters
C. people who worship the sun
[✓ D.] rather small people

27. A Bushman builds a house to live in

A. for his entire life
B. during the rainy season
[✓ C.] until he moves to a new place
D. during sandstorms

28. The territory of every Bushman band

A. is very small
B. changes from year to year
[✓ C.] is a vast stretch of land
D. seldom has a water hole

29. A skerm is a
S

[✓ A.] Bushman house
B. type of animal
C. hot, dry wind
D. stamping block for food

30. Bushmen

A. never see flowering plants
B. hide from the sun at noon
[✓ C.] struggle to find food and water
D. cannot find water during the dry season

31. All the desert animals

A. hide during the heat of the day
B. lap dew in the morning
C. store water in body sacs
[✓ D.] have ways of finding or storing water

32. Bushmen live in
S

A. very large bands of people
[✓ B.] bands of about twenty people
C. different bands at different times
D. bands only during the dry season

33. Werf is the Bushman name for
S

A. animal
B. tree
C. food
[✓ D.] camp

34. Baobab trees have
I

[✓ A.] great, thick trunks
B. large, underground roots
C. thin, short branches
D. shiny, hard bark

35. A large part of the Bushman diet is made up of
I

A. antelope meat
B. leopard tortoises
C. ngoa moths
[✓ D.] mongongo nuts

36. When Bushmen hunt large animals such as antelope, they

A. kill them with sharp spears
[✓ B.] shoot them with poisoned arrows
C. catch them with hooks
D. dig pits to catch them in

37. Bushmen use grasses for

D

A. feeding animals
B. covering sip wells
C. making animal traps
[✓ D.] building houses

38. The Kalahari Desert does NOT have

[✓ A.] pine trees
B. grasses and bushes
C. nuts and fruits
D. flowering plants

39. The Kalahari Desert

I

[✓ A.] covers more than one nation
B. is in northern Africa
C. has no people in it
D. has one large river

40. The land of the Kalahari

I

A. has dry, sloping hills
[✓ B.] is flat
C. is mountainous
D. has moving sand dunes

41. Material from the ngoa moth and the mamba is used for

S

A. food
[✓ B.] making poison
C. decorating eggshells
D. medicine

42. Smaller animals are hunted with

A. poisoned arrows
[✓ B.] poles and metal hooks
C. spears
D. ropes and nets

43. Hollow reeds 3-feet to 4-feet long are used

S

A. to dig plants
B. for spear handles
[✓ C.] in sip wells
D. to hook small animals

44. Leopard tortoises are

I

[✓ A.] easily caught
B. killed with clubs
C. shot with arrows
D. valued for the shell

45. A stamping block is used to

I

A. make arrows
[✓ B.] mash seeds and nuts
C. make designs for eggshells
D. pound the earth smooth

46. Women and children gather most of their plants

[✓ A.] miles away from the camp
B. at night when it is cool
C. inside the Bushman camp
D. wherever the hunters hunt

Name

(Answer sheet for the multiple-choice test)

Circle the BEST answer.

1. A B C D
2. A B C D
3. A B C D
4. A B C D
5. A B C D
6. A B C D
7. A B C D
8. A B C D
9. A B C D
10. A B C D
11. A B C D
12. A B C D
13. A B C D
14. A B C D
15. A B C D
16. A B C D
17. A B C D
18. A B C D
19. A B C D
20. A B C D
21. A B C D
22. A B C D
23. A B C D
24. A B C D
25. A B C D
26. A B C D
27. A B C D
28. A B C D
29. A B C D
30. A B C D
31. A B C D
32. A B C D
33. A B C D
34. A B C D
35. A B C D
36. A B C D
37. A B C D
38. A B C D
39. A B C D
40. A B C D
41. A B C D
42. A B C D
43. A B C D
44. A B C D
45. A B C D
46. A B C D

NAME ______________________________

Recognition Test

1. Circle the letters of the ones that occurred in the text:

   [✓ a.] As adults, they are 4 1/2 to just over 5-feet tall

   [✓ b.] a huge, 200-foot Baobab tree

   c. thorn fences surround the Bushman camp

   d. a leopard tortoise digging a sip well

   [✓ e.] a great stretch of dry land

   f. Rain never comes to the thirsty desert soil

   [✓ g.] find water where no one else would think to look

   h. a land of few rivers

2. Circle the letters of the ones that occurred in the text:

   [✓ a.] the water holes completely dry up

   b. antelopes are hunted with clubs

   [✓ c.] dig into underground burrows of animals

   D - d. traditional clothing is decorated with zig-zags

   [✓ e.] a carefully placed row of ostrich eggshells

   [✓ f.] Each band has its territory

   [✓ g.] an environment of little water and high temperatures

   h. hot nights and clear desert air all year long

3. Circle the letters of the ones that occurred in the text:

   a. little children help by catching birds

   [✓ b.] sucks water through the reed

   D- c. telling stories about the moon and the stars

   [✓ d.] small, cone-shaped houses made of sticks and grass

   [✓ e.] The tortoise is baked in the shell

   f. herds of animals tended by the Bushmen

   [✓ g.] Over 100 kinds of plants are gathered for food

   D-h. people leave the desert in their search for water

4. Circle the letters of the ones that occurred in the text:

D-a. the language spoken by the Bushmen is very unusual

b. large birds called vultures are seen swooping across the desert

[✓ c.] seek a drink or store water in surprising places

[✓ d.] Mongongo nuts are a major part of the Bushman diet

e. the bands fight each other fiercely for new territory

f. all food comes from animals killed by the Bushman hunters

[✓ g.] file iron pieces into points for arrowheads

h. Small holes are made in the sand for sleeping

5. Circle the letters of the ones that occurred in the text:

[✓ a.] once lived on the rich grasslands of South Africa

[✓ b.] venom of the deadly snake, the mamba

[✓ c.] find the dried-up leaves of the plant and dig

D-d. lions stalking zebras at dawn

[✓ e.] Any water left standing freezes at night

f. The hot, dry mountains of the desert

g. skerms and werfs eaten by the Bushmen

h. crops planted in the hot sun by the women and children

APPENDIX E

COMPUTER PROGRAMS

Example of FORTAP Program (GITAP) Used in Validation and Item Analysis of Tests

```
Notes     Listing

          ●MACC*STATLB.FORTAP

  1       *NEWJOB^^46^ITEM^^^^^32^SUBJECTS

  2       *KEYS^^^^^^^^^^^^PILOT^PILOT^STUDY^READ^GROUP^MC^TEST

  3                (Enter key cards here)

          *CRITERNINTERN

          *GITAP^^.^BISER

          *DATA^^^^^^^^^^^^^^^^^^^^^1^FMTCD

  4       ^^^^^^(10X,46A1)

  5                (Enter data cards here)

          *RUN

          ●FIN
```

Notes:

1 -Number of test items and subjects is variable. Number of subjects must begin in space 22.

2 -Group and test designations are variable.

3 -On the key cards, the first three spaces designate the number of the test item: the fourth space designates the number of possible answers to the item; the next four spaces are used to indicate which answer is correct, with 1000 for the first answer correct, 0100 for the second answer correct, etc.

4 -The number of test items (A1) is variable.

5 -One data card is punched for each student. Test results begin in space 11, and the number in each column indicates the answer given by the student. A2 in column 11 indicates that the student marked the second answer to question 1, and so on.

Example of SPSS Program Used for One-Way Analysis of Variance

```
Notes     Listing

          ●SPSS

  1       VARIABLE^LIST^^GRP,^V01^TO^V40

          INPUT^MEDIUM^^^CARD

  2       N^OF^CASES^^^^^132

  3       INPUT^FORMAT^^^FIXED^(F1.0,9X,2F1.0,1X,10F1.0,2X,4F1.0,1X,

          16F1.0,1X,2F1.0,1X,6F1.0)

  4       RECODE(V01,^V06,^V12,^V13,^V17,^V25,^V30,^V34,^V40)(1=1)

          (ELSE=0)

                    (Enter recode cards for other answers here)

          COUNT^^^^^^^^^^MCTEST^=^V01^TO^V40^(1)

  5       ONEWAY^^^^^^^^^MCTEST^BY^GRP^(1,6)/

          CONTRAST^=^.25^.25^.25^.25^-.5^-.5/

                    (Enter other contrast cards here)

          STATISTICS^^^^^ALL

          READ^INPUT^DATA

  6                 (Enter data cards here)

          FINISH

          ●FIN
```

Notes:

1 -This and all other cards in the program begin the variables in column 16. Variables here are group (GRP) and test items, V01 to V40.

2 -The total number of tests scored, 132 in this case, is variable.

3 -The program reads columns on the data cards marked F1.0, and ignores those marked X. In the example given, the first column (the group number) will be read, the next nine columns will be ignored, the next two will be read, etc.

4 -These are the items for which the correct answer is choice 1, hence (1=1). The next recode card would contain (2=1), etc.

5 -(1,6) indicates the six groups in the study; the number of groups is variable.

6 -Column 1 on the data cards is the group number. Other identifying information can appear in columns 2-9. Answers begin in column 10. A 3 in column 10 indicates that the student marked the third answer to question 1, and so on.